6TH ANNUAL MISSOURI RIVER NATURAL RESOURCES CONFERENCE

Missouri River Science

Meeting the Challenge of Change

PROGRAM

April 21-24, 2002
Marina Inn
South Sioux City, Nebraska

Missouri River Natural Resources Conference • 6th Annual • 2002

Missouri River at Niobrara, Nebraska
Nebraska Game and Parks Commission

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Conference Sponsors

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Additional financial support

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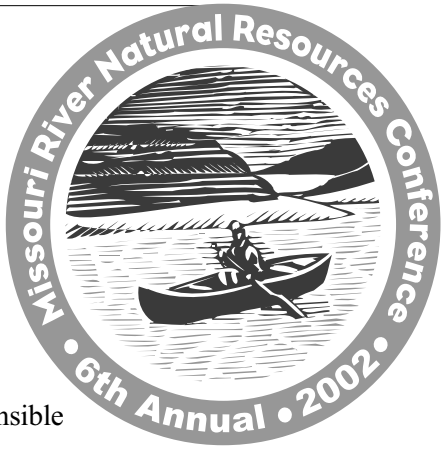
Welcome to Nebraska and South Sioux City in Particular!



As they always have, the winds of change continue to blow. However, before present generations can pass the torch of responsible stewardship to future generations, some work remains to be done.

Since its inception over two hundred years ago, the United States has passed through four eras of public land and resource management. First, was settlement and development of the public domain (1789-1834); second, there was a public land resource stewardship with a conservation ethic under President Theodore Roosevelt in the early 1900s; third, after World War II there was an ensuing national growth to include many water development projects (1941-1962); and fourth, was the environmental law era between 1962 and 1990. We have now moved into an era of watershed restoration and collaborative stewardship of big river systems, partly because we understand the form and function of rivers better, and partly because our values to sustain them have evolved with 20/20 hindsight.

With physical, chemical, biological, and social impacts identified in the latest U.S. Army Corps of Engineer's *Revised Draft Environmental Impact Statement for the Master Water Control Manual* and the recent National Research Council report, *The Missouri River Ecosystem: Exploring the Prospects for Recovery*, one could easily think about writing an epitaph for the Missouri River. On the other hand, both documents are about opportunities for change. In the end, the river will win. But for now, we must choose whether to view this enduring river from the standpoint of **"what can we get,"** or from the standpoint of **"what can we give back"?**

If we choose the latter, the decision will be an important one, not only for fish and wildlife resources and associated goods and services provided by a healthier river, but one with opportunities to grow into rewards for citizens, communities, the states, the nation and future generations. The steering committee and program chairs have worked hard to bring you a top notch program with experienced conference speakers and presenters, field trips to experience this part of the river, and the opportunity to ask questions. Change can be difficult and everyone is capable of naming fifty reasons not to change. There is however, at least one good reason to change - because it's the right thing to do. **Enjoy the Conference!**

Gene Zuerlein
Nebraska Game and Parks Commission
Lincoln, Nebraska

Program Contents

Bridge across the Missouri River connecting South Sioux City, Nebraska with Sioux City, Iowa

Conference Steering Committee

Gene Zuerlein, 2002 Chairman
Nebraska Game and Parks Commission
Lincoln, Nebraska

Yolanda Alanis
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University of South Dakota and Missouri River Institute
Vermillion, South Dakota

Jim Becic
Papio-Missouri River Natural Resources District
Omaha, Nebraska

Jeanne Heuser and Mark Laustrup
U.S. Geological Survey
Columbia, Missouri

Gary Ledbetter
U.S. Army Corps of Engineers
Yankton, South Dakota

Mike LeValley
Missouri River Natural Resources Committee
Missouri Valley, Iowa

Gerald Mestl
Nebraska Game and Parks Commission
Lincoln, Nebraska

Mike Olson
U.S. Fish and Wildlife Service
Bismarck, North Dakota

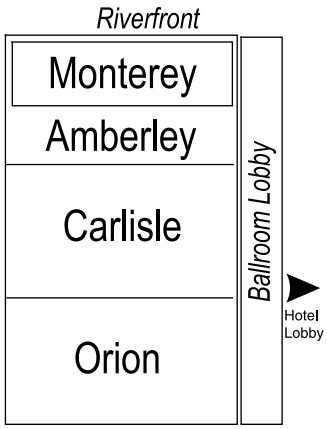
Richard Opper
Missouri River Basin Association
Lewistown, Montana

Larry Shepard
U.S. Environmental Protection Agency, Kansas City
Kansas City, Kansas

Chad Smith
American Rivers
Lincoln, Nebraska

Wayne Werkmeister
National Park Service
O'Neill, Nebraska

Schedule Overview



Hotel Conference Rooms

Sunday, April 21

9:00 a.m. - 5:00 p.m.	Niobrara Field Trip
Noon - 7:00 p.m.	Registration
	Exhibit and poster set-up - *Monterey and Amberley Rooms*
5:00 - 7:00 p.m.	Social - *Marina Inn Terrace (Riverfront)*
6:00 p.m.	Musical performance by Dave Para and Cathy Barton

Monday, April 22 - Earth Day

7:00 a.m. - 5:00 p.m.	Registration
7:00 a.m. - 7:00 p.m.	Exhibits and posters - *Monterey and Amberley Rooms*
8:00 a.m.	**Plenary** - *Carlisle-Orion Rooms*
10:30 a.m.	Break - *Monterey and Amberley Rooms*
11:00 a.m.	**Habitat Rehabilitation** - *Carlisle-Orion Rooms*
Noon	Lunch - *Monterey and Amberley Rooms*
	Concurrent Presentations
1:30 p.m.	(1) Endangered Species - *Carlisle Room*
	(2) Hydrology • Geomorphology • Water Quality - *Orion*
2:50 p.m.	Break - *Monterey and Amberley Rooms*
3:20 p.m.	(1) Endangered Species - *Carlisle Room*
	(2) Hydrology • Geomorphology • Water Quality - *Orion*
5:00 - 7:00 p.m.	**Social with exhibit and poster session**
	Monterey and Amberley Rooms
7:00 - 9:00 p.m.	**Banquet**
	Presentation by Congressman Douglas Bereuter

Tuesday, April 23

8:00 a.m.	Exhibits and posters - *Monterey and Amberley Rooms*
8:00 a.m. - 5:00 p.m.	Field Trip #1 - Missouri National Recreational River, Gavins Point Dam, and National Fish Hatchery
8:00 a.m. - 5:00 p.m.	Field Trip #2 - Lewis and Clark sites, rehabilitation sites
5:00 - 7:00 p.m.	Ponca Field Trip and Social

Wednesday, April 24

8:00 a.m. - Noon	Exhibits and posters - *Monterey and Amberley Rooms*
	Concurrent presentations
8:30 a.m. - Noon	(1) Biological Resource Trends • Habitat Relationships *Carlisle Room*
	(2) Geographic Information Systems (GIS) • Land Use • Recreational Use - *Orion Room*
9:50 a.m.	Break - *Monterey and Amberley Rooms*
Noon	Conference ends

Schedule

Sunday, April 21

9:00 a.m. - 5:00 p.m.	**Niobrara Field Trip** - *meet in hotel lobby*
Noon - 7:00 p.m.	**Registration -** *ballroom lobby* **Exhibit and Poster Set-up** *Monterey and Amberley Rooms*
5:00 p.m. - 7:00 p.m.	**Welcoming Social -** appetizers, cash bar *Marina Inn Terrace (Riverfront)*
6:00 p.m.	**Musical Performance** Dave Para and Cathy Barton *Marina Inn Terrace (Riverfront)*
7:00 p.m.	**Dinner** - on your own

Monday, April 22

Registration
7:00 a.m. - 5:00 p.m.

Exhibits & Posters
7:00 a.m. - 7:00 p.m.

PLENARY

8:00 a.m.	*Welcome* Gene Zuerlein, Nebraska Game and Parks Commission, Lincoln NE
8:15 a.m.	*Managing River Flows for Ecological Integrity.* Brian Richter, The Nature Conservancy, Charlotte VA (page 29)
9:00 a.m.	*Adaptive Management: Working the Water Management Conundrum.* Steve Light, Institute for Agriculture and Trade Policy, Minneapolis MN (page 30)
9:45 a.m.	*How Should We Proceed to Manage River Flows for Biodiversity?* David Galat, U.S. Geological Survey, Cooperative Research Unit, University of Missouri, Columbia MO (page 31)
10:30 a.m.	BREAK

HABITAT REHABILITATION

11:00 a.m.	*The Distribution of Conservation Lands on the Missouri River Valley Bottom, Sioux City, Iowa to St. Louis.* Mark S. Laustrup, U.S. Geological Survey, Columbia MO (page 32)
11:20 a.m.	*Iowa's Approach to Missouri River Mitigation Project Development.* Ed Weiner, Iowa Department of Natural Resources, Onawa IA (page 32)
11:40 a.m.	*Comparative Habitat Evaluations in Side-Channel Chute Rehabilitation Projects, Lower Missouri River.* Robert Jacobson, U.S. Geological Survey, Columbia MO (page 33)
Noon	LUNCH - Marina Inn

Schedule Monday, April 22

CONCURRENT SESSION 1 - Carlisle Room

ENDANGERED SPECIES

Moderator: Richard Holland, Nebraska Game and Parks Commission

1:30 p.m. *Pallid Sturgeon: What We've Learned in the Last Decade.*
Steve Krentz, U.S. Fish and Wildlife, Bismarck ND (page 34)

1:50 p.m. *The Corps of Engineers and the Biological Opinion: New Opportunities for Pallid Sturgeon Recovery.*
Mark Drobish, U.S. Army Corps of Engineers, Yankton SD (page 35)

2:10 p.m. *Pallid and Shovelnose Sturgeon in the Lower Missouri and Middle Mississippi Rivers.*
Joanne Grady, U.S. Fish and Wildlife Service, Columbia MO (page 35)

2:30 p.m. *Pallid Sturgeon Propagation at the Gavins Point National Fish Hatchery.*
Herb Bollig, U.S. Fish and Wildlife Service, Yankton SD (page 36)

2:50 p.m. BREAK

3:20 p.m. *Home Work, Fisherman Trains and B.F. Shaw.*
William Beacom, Nav-Con Services, Sioux IA (page 37)

3:40 p.m. *Habitat Use and Movement of Juvenile Pallid Sturgeon in the Missouri River.*
Wayne Stancill, U.S. Fish and Wildlife Service, Pierre SD (page 37)

4:00 p.m. *Least Tern and Piping Plover Response to the 1997 Flood Event on the Missouri River.*
Gregory Pavelka, U.S. Army Corps of Engineers, Yankton SD (page 38)

4:20 p.m. *Emergent Sandbar Habitat Trends below Gavins Point Dam.*
Bruce A.Vander Lee, U.S. Army Corps of Engineers, Yankton SD (page 38)

4:40 p.m. *Least Tern and Piping Plover Captive Rearing Program - A Review and Update.*
Rosemary Vander Lee, U.S. Army Corps of Engineers, Yankton SD (page 39)

SOCIAL 5:00 - 7:00 p.m.
Poster and Exhibit Session

CONCURRENT SESSION 2 - Orion Room

HYDROLOGY • GEOMORPHOLOGY • WATER QUALITY

Moderator: Mike Olson, U.S. Fish and Wildlife Service

1:30 p.m. *Fish Spawning and Discharge-Temperature Coupling along the Missouri River.*
David Galat, U.S. Geological Survey, Cooperative Research Unit, University of Missouri, Columbia MO (page 40)

1:50 p.m. *Long-Term Stage Trends on the Lower Missouri River Based on an Empirical Hydrologic Analysis.*
Reuben Heine, Southern Illinois University, Carbondale IL (page 41)

2:10 p.m. *Determination of the Natural Flow Regime of the Missouri River below Gavins Point Dam.*
Roger Kay, U.S. Army Corps of Engineers, Omaha NE (page 41)

2:30 p.m. *Use of Stream-Gage Information to Assess Changes in River-Channel Morphology.*
Kyle E. Juracek, U.S. Geological Survey, Lawrence KS (page 42)

2:50 p.m. BREAK

3:20 p.m. *Hydrological Effects of a Constructed Chute on Wetland Stage and Ground-Water Levels in the Missouri River.*
Brian P. Kelly, U.S. Geological Survey, Independence MO (page 43)

3:40 p.m. *A Whole-Lake Water Quality Survey of Lake Oahe Based on a Spatially-Balanced Probabilistic Design.*
David W. Bolgrien, U.S. Environmental Protection Agency, Duluth MN (page 43)

4:00 p.m. *Bad River Phase II Water Quality Project — A Success Story.*
Jerry Thelen, Stanley County Conservation District/Bad River Water Quality Project, Fort Pierre SD (page 44)

4:20 p.m. *Reservoir Sedimentation - A Time for Action.*
Howard Paul, Missouri Sedimentation Action Coalition, Wagner SD (page 45)

4:40 p.m. *Missouri River Interstate Water Quality - TMDL Concerns.*
Sharon Clifford, Missouri Department of Natural Resources, Jefferson City MO (page 46)

BANQUET 7:00 p.m.

Presentation by
Congressman Doug Bereuter

Schedule

Tuesday, April 23 - Field trips

8:00 a.m. - 5:00 p.m. - *Meet in hotel lobby*

Numbers relate to map on page 9.

Field Trip #1

(1) Missouri National Recreational River

A boat trip on the Missouri National Recreational River will show the few remaining semi-natural, dynamic reaches of the river. Though not numerous, pallid sturgeon are still reported by anglers in the reach where there are sandbars, multiple channels, islands, eroding banklines and snags. Still, most of the backwaters and side channels have been degraded by the loss of sediment trapped in the upstream reservoirs since Gavins Point Dam closed in 1957. High water in the late 90's created higher elevation sandbars providing nesting habitat for least terns and piping plovers.

(2) U.S. Army Corps of Engineers Lewis & Clark Visitor's Center

Gavin's Point Dam at Yankton, SD, is the most southern of the dams on the Missouri River main stem. It is here that the quantity of water released to the lower river is controlled. The dam marks the upstream end of the 59-mile Missouri National Recreational River.

(3) Gavins Point National Fish Hatchery

This Federal hatchery, one of 65 in the country, produces 12-16 species of fish including the endangered pallid sturgeon and the paddlefish, another species of concern.

Field Trip #2

(4-6) Lewis and Clark Sites

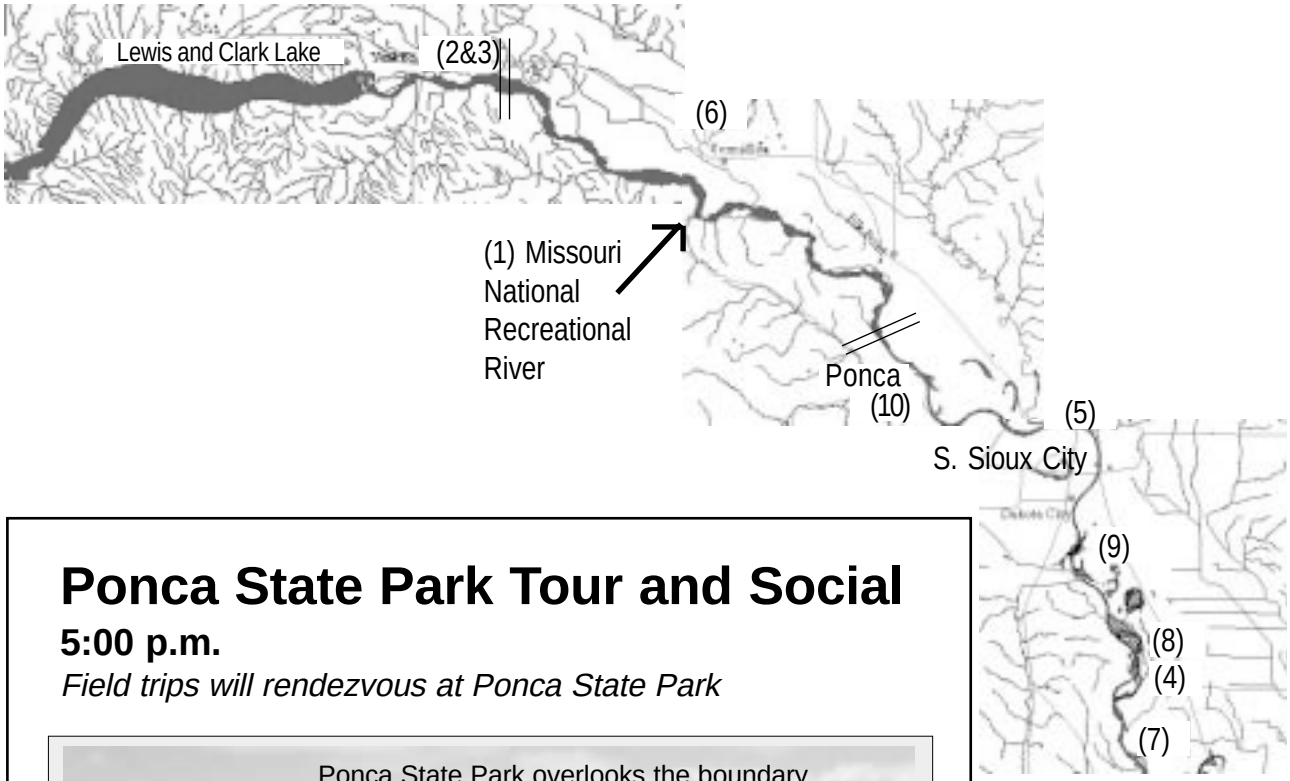
Trip to Lewis and Clark State Park at Onawa, IA where there is a restored L&C keelboat (4); the Sergeant Floyd Monument in Sioux City (5); and Spirit Mound north of Vermillion, SD (6).

(7-9) River Rehabilitation Sites

Tour local Missouri River habitat rehabilitation sites at Louisville Bend (7), Tieville/ Decatur/Blackbird Bend (8) and Snyder Bend/Winnebago Bend (9).

Developed by the U.S. Army Corps of Engineers and the Iowa Department of Natural Resources, these sites present an interesting contrast to sites further downstream because of constraints posed by bed degradation in the channel of the river north of Omaha.

Field Trips Map



Ponca State Park Tour and Social

5:00 p.m.

Field trips will rendezvous at Ponca State Park

Schedule Wednesday, April 24

CONCURRENT SESSION 1 - Carlisle Room

BIOLOGICAL RESOURCE TRENDS • HABITAT RELATIONSHIPS

Moderator: Rick Eades, Nebraska Game and Parks Commission

8:30 a.m. *Fishes and Habitat of the National Recreational River Segments of the Missouri River in South Dakota.*
Charles Berry Jr., U.S. Geological Survey, Cooperative Research Unit, South Dakota State University, Brookings SD (page 47)

8:50 a.m. *Fish Population Dynamics at Hamburg Bend.*
Steve Freeling, Nebraska Game and Parks Commission, Lincoln NE (page 48)

9:10 a.m. *Fish Community Monitoring at Lisbon Bottom, a Restoration Area on the Lower Missouri River.*
Louise Mauldin, U.S. Fish and Wildlife Service, Columbia MO (page 48)

9:30 a.m. *Effects of Woody Corridors on Levee Damage in the Flood of 1993.*
Stephen Allen, University of Missouri-Columbia, Columbia MO (page 49)

9:50 a.m. BREAK

10:20 a.m. *Sources of Spatial Variation in Shoreline-Associated Large Woody Debris in the Garrison Reach of the Upper Missouri River.*
Ted Angradi, U.S. Environmental Protection Agency, Denver CO (page 50)

10:40 a.m. *Landscape Structure and Composition in the Garrison Reach of the Upper Missouri River.*
E. William Schweiger, U.S. Environmental Protection Agency, Denver CO (page 50)

11:00 a.m. *Managing Missouri River Flood Plain Habitats in an Altered Landscape.*
Doug Helmers, USDA Natural Resources Conservation Service, Columbia MO (page 51)

11:20 a.m. *A Multi-Disciplinary Study of Flood Plain Wetland Ecology at Lisbon Bottom, Missouri.*
Duane Chapman, U.S. Geological Survey, Columbia MO (page 52)

11:40 a.m. *Purple Loosestrife - Can We Control It?*
Stevan Knezevic, University of Nebraska, Concord NE (page 53)

Wednesday, April 24

CONCURRENT SESSION 2 - Orion Room

GEOGRAPHIC INFORMATION SYSTEMS (GIS) • LAND USE • RECREATIONAL USE

Moderator: Jeanne Heuser, U.S. Geological Survey

8:30 a.m. *Temporal Changes in Land Use Practices in the Missouri River Watershed, South Dakota.*
Ken Higgins, U.S. Geological Survey, Cooperative Research Unit, South Dakota State University, Brookings SD (page 54)

8:50 a.m. *Development of a Decision Support System for the Missouri River – Lessons Learned from the Upper Mississippi River.*
Carl Korschgen, U.S. Geological Survey, Columbia MO (page 54)

9:10 a.m. *Depth Analysis on the Missouri River.*
Kevin C. Borisenko and Lee G. Hughes, Missouri Department of Conservation, Jefferson City MO (page 55)

9:30 a.m. *Using Digital Data Collection and the Internet – A Solution for Data Management.*
Bruce A.Vander Lee, U.S. Army Corps of Engineers, Yankton SD (page 55)

9:50 a.m. BREAK

10:20 a.m. *An Examination of the Physical Environment of the Lower Missouri River.*
Bill Little, Missouri Department of Natural Resources, Rolla MO (page 56)

10:40 a.m. *Influence of Katy Trail State Park and Lewis and Clark Activities on the Missouri River.*
Douglas Eiken, Missouri Department of Natural Resources, Jefferson City MO (page 57)

11:00 a.m. *Angling Recreational Use Patterns and Economics on the Missouri River System in South Dakota.*
Clifton Stone, South Dakota Game, Fish & Parks, Chamberlain SD (page 57)

11:20 a.m. *Missouri River Creel Survey.*
Kirk Steffensen, Nebraska Game and Parks Commission, Lincoln NE (page 58)

11:40 a.m. *Nebraska and South Dakota 2000 Missouri River Recreational Use Survey.*
David Tsoodle, Nebraska Game and Parks Commission, Lincoln NE (page 59)

Exhibits

American Rivers
Chad Smith
Mill Towne Building
650 J Street, Suite 400
Lincoln, NE 68598
402-477-7910
csmith@amrivers.org

Environmental Systems Research Institute, Inc. (ESRI) St. Louis
Stephen Kinzy
820 South Main Street, Suite 207
St. Charles, MO 63301
636-949-6620
skinzy@esri.com

Hydrolab
Dave Procyk
8700 Cameron Road, Suite 100
Austin, TX 78754
800-949-3766 x271
dprocyk@hydrolab.com

Missouri River Institute
Bruce Barton
414 East Clark Street
Vermillion, SD 57069-2390
605-677-6180
bbarton@usd.edu

Missouri Sedimentation Action Coalition
Howard Paul
P.O. Box 1253
Pierre, SD 57501
605-773-7341
kevin.king@ci.pierre.sd.us

National Park Service
Wayne Werkmeister
P.O. Box 591
O'Neill, NE 68763-0591
402-336-3970
Wayne_Werkmeister@nps.gov

Nebraska Game and Parks Commission
Gene Zuerlein
P.O. Box 30370
2200 N. 33rd Street
Lincoln, NE 68503-0370
402-471-1542
zuerlein@ngpc.state.ne.us

Papio-Missouri Natural Resources District
Jim Becic
8901 S. 154th Street
Omaha, NE 68138-3621
402-444-6222
jbecic@papionrd.org

South Dakota State University
Chuck Berry
Cooperative Research Units
P.O. Box 21406
Brookings, SD 57007
605-688-6121
Charles_Berry@sdstate.edu

U.S. Army Corps of Engineers-Kansas City
Ken Wilk
Lewis and Clark Bicentennial
5260 Pomona Dam Rd.
Vassar, KS 66543-9212
785-453-2338
Kenneth.S.Wilk@usace.army.mil

U.S. Environmental Protection Agency-Kansas City
Larry Shepard
901 North 5th Street
Kansas City, KS 66101
913-551-7441
shepard.larry@epa.gov

U.S. Fish and Wildlife Service
Ecological Services
Louise Mauldin
608 East Cherry
Columbia, MO 65201
573-876-1911 x118
Louise_Mauldin@fws.gov

U.S. Fish and Wildlife Service
Big Muddy National
Fish and Wildlife Refuge
Tim Haller
4200 New Haven Road
Columbia, MO 65201
573 876 2799
Tim_Haller@fws.gov

U.S. Geological Survey
Columbia Environmental
Research Center
Missouri River InfoLINK
Jeanne Heuser
4200 New Haven Road
Columbia, MO 65201
573-876-1876
Jeanne_Heuser@usgs.gov

U.S. Geological Survey
EROS Data Center
Carrie Jucht
Mundt Federal Building
Sioux Falls, SD 57198
605-594-6800
cjucht@usgs.gov

U.S. Geological Survey
Lewis and Clark Outreach Committee
Dale Blevins
301 W. Lexington
Independence, MO 64050
816-254-8172
dblevins@usgs.gov

U.S. Geological Survey
Kaylene Carney
P.O. Box 1230
Iowa City, IA 52244
319-358-3612
kfcarney@usgs.gov

University of Missouri
Tabitha Madzura
University of Missouri
Outreach & Extension
232 Agricultural Engineering
Columbia, MO 65211-5200
573-882-0085
madzurat@missouri.edu

University of Nebraska
Ed Peters
School of Natural Resource Science
University of Nebraska-Lincoln
202 Natural Resources Hall
Lincoln, NE 68583
402-472-6826
epeters2@unl.edu

University of South Dakota
Bruce Barton
414 East Clark Street
Vermillion, SD 57069-2390
605-677-6180
bbarton@usd.edu

Winnebago Tribe of Nebraska
Yolanda Alanis
P.O. Box 687
Winnebago, NE 68071
402-878-2272
Tribalplanner@aol.com

Posters

Posters are listed alphabetically by title.

Detailed descriptions of posters on pages 17- 29.

Posters

Posters listed alphabetically by title.

A Biotic Survey of a Backwater and Bottomland along the Missouri River National Recreational River in Ponca State Park, Nebraska

Bryan R. Gasper[1], Eric T. Liknes[1], Steven R. Chipps[2], and Bruce A. Barton[1]

[1]- Department of Biology and Missouri River Institute, University of South Dakota, Department of Biology, Vermillion, SD 57069, 605-624-7957, bgasper@usd.edu

[2]- USGS, South Dakota Cooperative Fish & Wildlife Research Unit, South Dakota State University, Brookings, SD

Ponca State Park, located on the extreme downstream end of the 59-mile Missouri National Recreational River, recently acquired a 425-acre bottomland adjacent to the river. This area is slated for an extensive restoration project including the renovation of chutes, backwaters, and oxbows, as well as the reintroduction of native prairie species. Prior to restoration, a systematic inventory of the biotic community within the addition was conducted during the summer of 2001. Specifically, the survey focused on a backwater, vegetated sandbars, overgrown agricultural fields, and immature cottonwood stands. Protocol established and data obtained will be used to evaluate changes after the restoration of the bottomland is completed. The fish, bird, small mammal, reptile, and amphibian communities were surveyed and analyzed for habitat usage and species distribution. During the period from June to September, the survey yielded communities with patterns of high abundance and low diversity. Initial data analyses documented the presence of 55 bird species, 6 amphibian and reptile species, 4 small mammal species, and 15 fish species as adults. One federally endangered species, least terns (*Serna antillarum*), as well as two Nebraska Heritage Species, masked shrews (*Sorex cinereus*) and false map turtles (*Graptemys pseudogeographica*), were observed frequenting the area. Additional analysis will include relative abundances and diversities of juvenile and larval fishes and benthic invertebrates, and stable isotope analysis of the aquatic community to determine trophic interactions.

A Proposed Framework for Development and Validation of an Aquatic Macroinvertebrate Bioassessment Program for the Lower Missouri River

Barry C. Poulton
U.S. Geological Survey, Columbia Environmental Research Center, 4200 New Haven Road, Columbia, MO 65201, 573- 876-1873, barry_poulton@usgs.gov

Biological assessments utilizing macroinvertebrate communities have received widespread acceptance as indicators of overall water resource quality in flowing waters. Historically, Missouri River macroinvertebrates were studied for demonstrating the ecological value of river training structures, production comparisons between habitats, and measuring effects of channelization and power plant discharges. However, no comprehensive biological assessment program has ever been implemented in the lower Missouri River, even though basic approaches were proposed as part of MoREAP (Missouri River Environmental Assessment Program). The USGS Columbia Environmental Research Center in collaboration with other federal and state agencies, has designed a comprehensive framework for conducting research and monitoring activities with aquatic macroinvertebrates in the

lower Missouri River system, which represents an expansion of the biological component presented in the MoREAP document. The proposed bioassessment framework outlines goals and procedures that rely on the successes and failures of monitoring activities that exist on other large rivers, and are congruent with state programs currently being used for wadable streams. Included are recommended methods and approaches for validation of macroinvertebrate endpoints, and for measuring water and habitat quality, relative biological condition, temporal community changes, reach comparisons, and longitudinal effects of cumulative anthropogenic disturbances. The proposed methodologies will also be valuable for development of large river biocriteria, tracking the effects of exotics, and integration of research needs with that of other fish and wildlife species in the basin.

Abundance and Biodiversity of Aerial and Terrestrial Invertebrates in the Benedictine Bottoms

Summer Jackson
Benedictine College, 1020 North Second Street, Atchison, KS 66002, 913-367-5340, c/o msimon@benedictine.edu

Co-authors: Nicole Bruckerhoff, Zac Cusumano, Michele Gamboa, Grant Latta, Daniel Bowen, Martin Simon, Benedictine Bottoms Missouri River Biodiversity Assessment Program, Biology Department, Benedictine College, Atchison, KS

Benedictine College Biology Department is monitoring the biodiversity of the Benedictine Bottoms Mitigation Site, including the invertebrates inhabiting the area. Invertebrate sampling was conducted from May 1995 until October 2001 along randomly chosen transects. Sticky traps were set 1-1.3m off the ground with 96cm^2 covered with Tanglefoot to collect aerial invertebrates. Pitfall traps were set in the ground and filled with 2.5 cm of preservative to collect terrestrial invertebrates. A sample depth of 432cm and an area of 179cm^2 was used for each sampling. Collected specimens were preserved in 75% ethyl alcohol until identification. Since 1995, over 66 thousand invertebrates have been collected and identified to order. The five most commonly occurring terrestrial orders are: Orthoptera, Coleoptera, Collembola, Aranae, and Diptera from highest to lowest respectively. The five most commonly occurring aerial orders are: Diptera, Coleoptera, Thysanoptera, Hymenoptera, and Homoptera. The data analyzed up to this point, using ANOVA, has shown that the year, month, and habitat are significant factors in determining the abundance of invertebrates. Aerial invertebrates abundance through 1995 to 1998 has shown an overall downward trend, with a small increase in 1999. The highest abundance occurs in May and June with a decline in abundance approaching the first frost in late October. Terrestrial invertebrates have shown a fluctuation in abundance between the years of 1997 and 1999 with the greatest in 1998. July showed the greatest abundance of terrestrial invertebrates decreasing up to the first frost.

Aquatic and Wildlife Habitat Restoration on the Missouri River

Richard Gorton
HDR Engineering Inc., 8404 Indian Hills Drive, Omaha, NE 68114, 402-399-1246, ksrb@hdrinc.com

HDR has completed a series of restoration projects along the Missouri River. The projects included aquatic and wildlife habitat as well as wetland restoration encompassing approximately 10,000 acres of the Missouri River. One project has been completely constructed and another is scheduled for construction late this year.

HDR performed hydraulic modeling and analyses to restore riverine habitat at three locations along Overton Bottoms. Different alternatives were modeled, screened, and evaluated based on engineering feasibility, ability to remain viable with minimal maintenance, and for construction and operation and maintenance costs. The Overton Bottoms project was constructed in 2000-2001.

The Lower Hamburg Bend mitigation project proposes to re-open a historic chute connection to the Missouri River in order to restore wetlands and fish and wildlife habitat. Different scenarios for re-opening the chute were modeled to determine the best alternative for a viable chute that could meet mitigation objectives. Construction of the Lower Hamburg Bend project is tentatively scheduled for Fall 2003.

The Blackbird-Tieville-Decatur Bend project, HDR designed a restoration project that encom-passed fish habitat, wetland restoration and terrestrial habitat restoration. Several innovative designs were developed to provide for fish passage and reduce backwater sedimentation in the restored chute areas.

HDR is also preparing the Supplemental Environmental Impact Statement for the Missouri River Fish and Wildlife Habitat Mitigation project. The purpose of the project is to restore a portion of the approximately 550,000 acres of fish and wildlife habitat that have been and will be lost through the year 2003 due to the Bank Stabilization and Navigation project. Additionally, HDR is preparing the Section 33 Environmental Impact Statement to evaluate the cumulative impacts of bank stabilization on the upper Missouri River.

Bird Biodiversity on the Missouri River Benedictine Bottoms Wildlife Mitigation Site from 1994-2001

Jill Hellmer
Benedictine College, 1020 North Second Street, Atchison, KS 66002, 913-367-5340, c/o msimon@benedictine.edu

Co-authors: Tiffany Cope, Erik Sasovetz, Manda Lee, Daniel E. Bowen, Martin P. Simon. Benedictine Bottoms Missouri River Biodiversity Assessment Program, Department of Biology, Benedictine College, Atchison, KS

The documentation of bird diversity is part of a larger study of emerging biodiversity taking place on the Benedictine Bottoms (Bottoms). The Army Corps of Engineers purchased the agricultural land in 1992. It is located on the west side of the Missouri River about 3 kilometers northeast of Atchison, Kansas and is now

managed by the Kansas Department of Wildlife and Parks. In efforts to transform the Benedictine Bottoms from agricultural land to a managed riparian hardwood forest-wetland complex, the land has been planted with over 175,000 trees and 302 hectares of native grass, while maintaining 16 wetland units.

Systematic observation of 72757 individual birds have been made since December 1994. Of the 137 total species, we have observed 41 woodland species and 96 prairie/wetland species. In 1994, 41 species were observed. In 1995, 59 of 94 total species seen were new. In 1996, there were 86 species seen, 20 of these were new species. In 1997 of the 90 species seen only 13 were new to the Bottoms. In 1998, only 2 new species were seen of the 55 total. In 1999, 1 new species was seen out of 53. No new species were observed in 2000 and only 1 new species was observed in 2001. A regression analysis of annual variation of new species predicts a complete avifauna at less than 160 species on the Benedictine Bottoms. Interestingly the avifauna at the nearby benchmark bird community, Squaw Creek National Wildlife Refuge, has 273 species.

Comparisons of Shovelnose Sturgeon and Pallid Sturgeon in the Lower Platte River, Nebraska

Benjamin D. Swigle and Edward J. Peters
School of Natural Resource Science, 202 Natural Resources Hall, University of Nebraska-Lincoln, Lincoln, NE 68583, 402-472-6826,
benjaminswigle@hotmail.com

Populations of shovelnose *(Scaphirhynchus platorynchus)* and pallid sturgeon *(Scaphirhynchus albus)* have declined since the early 1900's making information on their habitat requirements essential for their recovery. We studied movements and habitat use of shovelnose and pallid sturgeon in the lower Platte River, Nebraska using radio telemetry. Ten shovelnose sturgeon (range, 588-693 mm fork length; 0.75-1.25 kg weight) and one wild pallid sturgeon (880 mm fork length; 2.45 kg weight) were equipped with radio transmitters and observed using airboat and aerial surveys. Four of 10 shovelnose sturgeon exhibited coordinated upstream movements averaging 110 km. By July 17th, 2001, all of these fish had moved back downstream to within 10 km of their initial starting locations. The other six remained within 5 km of their respective release sites. Shovelnose sturgeon used water depths averaging 0.91 m, mean column velocities averaging 0.60 m/s, and bottom current velocities averaging 0.36m/s. The single female pallid sturgeon, caught on May 3rd, 2001, was released 12.5 km upstream of the convergence of the Platte and Missouri Rivers. This fish remained near its release site for approximately three weeks and then traveled downstream, entering the Missouri River on June 9th, 2001. The pallid sturgeon was located 10 times in water depths averaging 1.17 m, mean column velocities averaging 0.86 m/s, and bottom current velocities averaging 0.66 m/s. Results from both shovelnose and wild pallid sturgeon are similar to those found for hatchery-reared pallid sturgeon in the Platte River.

Posters

Cyprinid and Catostomid Drift in the Lower Platte River, Nebraska

Cory N. Reade and Edward J. Peters
School of Natural Resource Science, 202 Natural Resources Hall, University of Nebraska-Lincoln, Lincoln, NE 68583, 402-472-0825, creade2@unl.edu

To determine the importance of water temperature and discharge on reproduction of fish in the Platte River, we collected larval fish and eggs one day every other week, from May to August in 1998, 1999, and 2000 at river kilometer 44.2. On those days stationary drift nets were set every three hours over a 24-hour period. During opposite weeks, four sites were sampled between river kilometers 0 and 171. Cyprinids made up the largest proportion of larvae collected at 87%, 91%, and 79% of all larvae in 1998, 1999, and 2000, respectively. In these same years, Macrhybopsis spp. larvae composed 20%, 52%, and 1% of cyprinids. Peaks in cyprinid larval drift, especially Macrhybopsis spp., corresponded with discharge peaks in 1999 and 1998, but not in 2000. Peak flows in 2000 were late in the summer and resulted from local storm events, while 1998 and 1999 peaks coincided with snowmelt runoff from upstream. Over the study period, catostomids composed 6%, 7%, and 12.6% of all larvae collected. Blue sucker larvae were collected in 1998, 1999, and 2000. In 1998, blue sucker larvae were only collected at the furthest downstream site. In 1999, a blue sucker larva was collected at North Bend (river kilometer 116), but larvae were most abundant at the downstream site. Blue sucker larvae were collected at three sites in 2000. Drift of blue sucker larvae did not appear to correspond to discharge events, but specific explanations of relationships between spawning and discharge patterns are not clear.

Deer Population Structure on the Benedictine Bottoms Missouri River Mitigation Site (1994-2002)

Kyle Kellner
Benedictine College, 1020 North Second Street, Atchison, KS 66002, 913-367-5340, c/o msimon@benedictine.edu

Co-authors: Jesse Lindquist, Kyle Schrick, Ben McBride, Daniel Bowen, Martin Simon, Benedictine Bottoms Missouri River Biodiversity Assessment Program, Biology Department, Benedictine College, Atchison, KS

The Army Corps of Engineers has restored 855 ha. of agricultural land 1.5km northeast of Atchison, KS to its natural Missouri River flood plain habitat. The mitigation site, named the Benedictine Bottoms, is managed by the Kansas Department of Wildlife and Parks. As part of an effort to determine the presence and abundance of mammals residing on the bottoms, deer spotlight surveys were conducted on a six kilometer portion of elevated road surrounding the bottoms and adjacent agricultural land during the fall and winter from 1994-2002. These surveys serve to determine the population structure of the white-tailed deer, a mammal of particular interest on the bottoms. In 2000, an average of 72.6 deer were seen on each survey. This is twice the average number observed in 1999. Does represented 36.9% of the population in 2000, and fawns represented 36.3%. Bucks (5.0%) and sub-bucks (2.8%) were much less common, while 19% were unclassified. For the first time since the survey began in 1994, more deer were found in the adjacent

agricultural land than on the bottoms. Factors found to affect deer abundance on the Benedictine Bottoms were temperature, month, and time of day. Moon phase and cloud cover were not significant factors.

Floristic Studies of Natural Plant Recolonization on the Benedictine Bottoms Wildlife Mitigation Site

Bethany James
Benedictine College, 1020 North Second Street, Atchison, KS 66002, 913-367-5340, c/o msimon@benedictine.edu

Co-authors: Catherine Wiegand, Larissa Hilger, Erin Urban, Daniel Bowen, Martin Simon, Jack Davis, Benedictine Bottoms Missouri River Biodiversity Assessment Program, Biology Department, Benedictine College, Atchison, KS

The transition of the Benedictine Bottoms from farmland back to flood plain habitat began when the U.S. Army Corps of Engineers (Corps) purchased the site in 1992. Between 1994 and 1997 the Corps planted 200 hectares with 176,000 trees and shrubs as well as an additional 300 hectares with native grass species and legumes. Native species also recolonised naturally.

The floristic study, in which any plant in boom or seed is collected, preserved, and identified using *Flora of the Great Plains*, determines species that have been lost or added through ecological succession. This is a continual study divided into five year cycles. The first cycle began May 1995 and was completed in 2000. Plants collected through the 1999 growing season totaled 47 Families, 103 Genera and 127 Species. We are currently analyzing the second cycle, to be completed in 2004.

GIS Base Data Resources for the Missouri River in South Dakota

Tim Cowman
South Dakota Department of Environment and Natural Resources - Geological Survey Program, 414 East Clark Street, Akeley Science Center, Vermillion, SD 57069, 605-677-6151, tcowman@usd.edu

The State of South Dakota has made significant progress in acquiring GIS base data statewide. This includes the Missouri River area in the state. Digital products representing aerial photography, topographic maps, and elevation models are all available for use in GIS. These products make up a very useful digital base on which other data can be overlain for analysis and presentation. The GIS base data is also useful for determining locations of river features, as well as change that has occurred along the river over the years. Distribution of the GIS base data is implemented through the South Dakota Geological Survey web site. Users can download digital aerial photography, scanned topographic maps, and digital elevation models from the web site through a user-friendly interface.

BIO: Tim Cowman is a Natural Resources Administrator with the Geological Survey Program in the South Dakota Department of Environment and Natural Resources. He has a Masters Degree in Natural Sciences from the University of South Dakota. Tim has experience in aquifer mapping, geochemical research, wellhead protection and monitoring, GIS, and GPS technology.

Posters

Impacts of Landscape Change on Environmental Quality in Headwater Areas

Tony Prato
University of Missouri-Columbia, 212 Mumford Hall, Columbia, MO 65211, 573-882-0147, PratoA@missouri.edu

While natural disturbance (fire, windstorms, avalanches, landslides, treefall, floods, insect epidemics and climate variability) influences and shapes ecological processes, human-induced change in land cover/use is the most important determinant of ecological and environmental degradation. Land-related human causes of degradation in natural landscapes and impairment of ecological functions and processes include urbanization, conversion of forests to agriculture, drainage of wetlands and forest fragmentation. More than 90 percent of the land in the Lower 48 states has been logged, plowed, mined, overgrazed, paved or otherwise modified from presettlement conditions. Primary drivers of human-induced landscape change include population growth, economic development and natural resource extraction.

Sustainable management of natural landscapes and associated ecosystems can reduce adverse ecological and environmental impacts of human-induced landscape changes. The need for sustainable landscape management is especially critical in rapidly growing and environmentally impacted headwater areas of major river basins. This paper discusses how advances in information technologies (remote sensing, GIS and GPS) and landscape ecology, greater availability and accuracy of geospatial data, and increased accessibility and functionality of Internet technologies offer unprecedented opportunities for sustainable landscape management. The paper argues that such advancements make it possible to: a) improve scientific understanding of the complex spatial and temporal interactions between economic development, landscape change and ecological integrity, b) predict the impacts of future economic development and associated landscape changes on ecological integrity and economic activity, and c) incorporate scientific knowledge into decision tools for improving sustainable landscape management.

BIO: Tony Prato is Professor of Ecological Economics, Chair of the Department of Agricultural Economics, Co-Director of the Center for Agricultural, Resource and Environmental Systems, and Director of the Missouri River Institute at the University of Missouri-Columbia.

Lewis and Clark's Lower Missouri River Plants on the Benedictine Bottoms Wildlife Mitigation Site

Catherine Wiegand
Benedictine College, 1020 North Second Street, Atchison, KS 66002, 913-367-5340, c/o msimon@benedictine.edu

Co-authors: Bethany James, Erin Urban, Larissa Hilger, Daniel Bowen, John Davis, and Martin Simon, Benedictine Bottoms Missouri River Biodiversity Assessment Program, Biology Department, Benedictine College, Atchison, KS

The Water Resources Development Acts of 1986-1990 authorized the Army Corps of Engineers to mitigate wetlands along the lower Missouri River that had been converted to agricultural use following the river's channelization. Mitigation

functions to restore disturbed habitats to previous 'natural' conditions. An insight into earlier natural conditions comes from the natural history writings by members of the Lewis and Clark expedition while on the lower Missouri River. The expedition camped on the flood plain housing the Benedictine Bottoms on July 4, 1804. William Clark was the principal journalist on the lower Missouri River and he described the plants; Meriwether Lewis collected the herbarium specimens from the lower Missouri River. A modern annotated list of 108 plants was compiled from the three major publications of the journals that included natural history, which were edited by Elliott Coues, Reuben Thwaites, and Gary Moulton. All of the plants except one are listed in the *Flora of the Great Plains.* During the bicentennial of the Lewis and Clark expedition from 2003-2006, this plant list may be usefully compared to modern flora or serve as a basis for the mitigation of lost habitat on the Missouri River. A comparison of the Benedictine Bottoms list of 132 plants to the Lewis and Clark list shows that only 17 species, such as the sugar maple, big blue stem, and cottonwood are on both lists.

Missouri National Recreational River : (Almost) 25 years of Legislation and Implementation (59-Mile District)

Rebecca J Latka
U.S. Army Corps of Engineers, 106 S. 15th Street, Omaha, NE 68102, 402-221-4602, Rebecca.j.latka@usace.army.mil

The poster will consist of a pictorial timeline of the Missouri National Recreational River from pre-legislative studies in the early 1970's through the 1978 legislation, and continuing on through current actions. Construction actions, environmental studies, and other studies conducted under this legislation by the Corps will be included. Construction actions consist of boat access areas at Riverside Park, Yankton and at Myron Grove, South Dakota; least tern and piping plover island construction; an off-shore erosion control structure at Ponca State Park, Nebraska; and a bank protection structure at an eagle nesting area on the Nebraska side. Studies include mussel surveys, steamboat surveys, erosion studies, water quality studies, eagle nest surveys, fish studies. Current construction actions, studies, and future plans will also be described, including the Ponca Resource and Education Center, the Ponca backwater restoration project, the cottonwood regeneration study, and continued water quality studies to name a few.

BIO: Becky is the Corps' Project Manager for the Missouri National Recreational River.

Missouri River Basin Consortium

Tony Prato
University of Missouri-Columbia, 212 Mumford Hall, Columbia, MO 65211, 573-882-0147, PratoA@missouri.edu

The poster will describe the goals, objectives and activities of the Missouri River Basin Consortium (MRBC). MRBC is a consortium of institutions of higher learning that coordinates and promotes basin-wide interdisciplinary research, educational and outreach programs in the basin. The goal of MRBC is to advance knowledge and

understanding of cultural, ecological, economic, historical and social issues in the Missouri River Basin. Current members of the MRBC include Benedictine College (Kansas), Colorado State University, Iowa State University, Kansas State University, Montana State University, North Dakota State University, South Dakota State University, University of Missouri, University of Nebraska, University of South Dakota and University of Wyoming. The MRBC will develop a broad range of research and educational programs and activities dealing with the use, management, restoration and appreciation of natural and human resources in the Missouri River Basin. MRBC has developed eight initiatives: a) surveying basin stakeholders, b) holding a conference on the scientific basis for river management, c) conducting biodiversity assessments and evaluation of remediation efforts, d) evaluating socioeconomic impacts of river management alternatives, e) assessing biogeochemical processes, e) implementing educational programs, f) fostering appreciation for the culture of the Missouri River, and g) developing an NPR program in support of the Lewis and Clark Bicentennial Celebration. The poster will solicit other educational institutions in the Missouri River Basin to join the MRBC.

BIO: Tony Prato is Professor of Ecological Economics, Chair of the Department of Agricultural Economics, Co-Director of the Center for Agricultural, Resource and Environmental Systems, and Director of the Missouri River Institute at the University of Missouri-Columbia. (Eleven MRBC members jointly author the poster.)

Population Abundance and Diversity of Small Mammals on the Benedictine Bottoms from 1995-2002

Jesse Lindquist
Benedictine College, 1020 North Second Street, Atchison, KS 66002, 913-367-5340, c/o msimon@benedictine.edu

Co-authors: Kyle Kellner, Kyle Schrick, Ben McBride, Martin P. Simon and Daniel E. Bowen, Benedictine Bottoms Missouri River Biodiversity Assessment Program, Biology Department, Benedictine College, Atchison, KS

The Benedictine Bottoms is a mitigation site developed by the U.S. Army Corps of Engineers to renew the natural flood plain habitat along the Missouri River. The bottoms consists of 2300 acres of flood plain habitat. The goal of our research is to measure the changes in biodiversity associated with this mitigation. 20-30 small mammal traps are placed at each of 3 transects each month. The traps are checked for three consecutive days. In addition the mammals seen on the bottoms during these days are also recorded. The most abundant species to date on the bottoms is the deer mouse *(Peromyscus maniculatus)*. Other abundant species include the hispid cotton rat (*Sigmodon hispidus)*, prairie vole, and house mouse (*Mus musculus)*. To date there have been 11 species trapped on the bottoms. 51% of the species occurring at the Fort Leavenworth bench mark site also occur on the bottoms. Not observed on the bottoms are squirrels and bats. Small mammal abundance has differed significantly in different years. The peak abundance of small mammals occurred in the month of November. Small mammal abundance has not been shown to be significantly affected by rainfall.

Qualitative Analysis of the Survivorship of Burned versus Non-burned Corps Planted Trees Found on the Benedictine Bottoms Wildlife Mitigation Site

Erin Urban
Benedictine College, 1020 North Second Street, Atchison, KS 66002, 913-367-5340, c/o msimon@benedictine.edu

Co-authors: Larissa Hilger, Bethany James, Catherine Wiegand, Daniel Bowen, Martin Simon, John Davis, Benedictine Bottoms Missouri River Biodiversity Assessment Program, Biology Department, Benedictine College, Atchison, KS

Before the growing season of 1994, the Army Corps of Engineers began planting 1/4th of a total of 176,000 trees and shrubs on 223 hectares. Plantings were continued from 1995 to 1997 and starting in 1997, the survivorship of the initial 1/4th of the Corps planted trees were assessed. The successive 1/4^{ths} were then also assessed after three years. After three years, 9% of trees survived from 1994, 25% from 1995, 12% from 1996, and 15% from the 1997 planting. In spring of 2000, a fire burned the 1995 site and partially burned the 1996 tree planting site. The effects of the fire were measured by sampling tree height, survivorship, and numbers of stems sprouting from the roots. The 1995 site had an average of 80.33 trees per acre in 1998 and after the fire, in 2000, had an average of 66.8 trees per acre. The 1996 site, which was partially burned, had an average of 86.43 trees per burned acre and 40.45 trees per unburned acre. Unburned trees were an average of one meter taller than burned trees. All burned species were shorter after burning with sycamores being the most affected. Only 53% of trees in the unburned plots had multiple stems, compared to 70% in burned plots. The fire did not significantly effect survivorship but the trees were significantly shorter and significantly more had multiple stems.

Reducing Sedimentation to the Missouri River in South Dakota through Conservation Practices

Joby Timm
Natural Resources Conservation Service, P.O. Box 1258, Pierre, SD 57501, 605-224-2476, joby.timm@sd.nrcs.usda.gov

Bad River sediment entering the Missouri River at Fort Pierre.

The presentation will look at the results of the Bad River - River Basin Study. It will identify where the sediment is coming from in the Bad River Basin, how much sediment is getting to the Missouri River and what conservation practices can be used to reduce the sediment load that is entering Lake Sharp from the Bad River. The study has identified stream bank and channel erosion as the main source of sediment from the Bad River. The use of conservation practices such as rotational grazing, cross fencing, and stockwater distribution can provide major reductions in sediment delivered to the Missouri River system.

Reducing the Field Handling Time of Sturgeon

Kirk Steffensen
Nebraska Game and Parks Commission, 2200 North 33rd Street, Lincoln, NE 68503, 402-471-5447, gmestl@ngpc.state.ne.us

Co-authors: Gerald Mestl and Jay Francis, Nebraska Game and Parks Commission, Lincoln, NE

The Nebraska Game and Parks Commission has been looking at ways to reduce the field handling time of sturgeon and subsequently reduce the stress imposed upon the fish. In order to differentiate between pallid sturgeon, shovelnose sturgeon and hybrids, researchers have developed several character indexes using various combinations of meristics and morphological measurements. The collection of these data can take several minutes per fish. We are in the process of comparing the results of field measurements to the use of photographs. Slides were taken of the head, dorsal and anal fins. These slides are being scanned and analyzed using customized digitizing software program. The results of the field data will then be compared to the results obtained from the laboratory analysis.

BIO: B.S. from Wayne State in 2000. Started with Nebraska Game and Parks Commission as a Conservation Technician in 2000. Promoted to Biologist in September of 2001 and is currently working on a pallid sturgeon monitoring project funded by the Corps of Engineers.

Reptile and Amphibian Abundance on the Benedictine Bottoms Wildlife Mitigation Site

Michael Nations
Benedictine College, 1020 North Second Street, Atchison, KS 66002, 913-367-5340, c/o msimon@benedictine.edu

Co-authors: Michael J. Urban, Ben McBride, Justin Windham, Daniel Bowen, Martin P. Simon, Benedictine Bottoms Missouri River Biodiversity Assessment Program, Biology Department, Benedictine College, Atchison, KS

In response to the decline of wetland habitats in the Missouri River floodplain, the U.S. Army Corps of Engineers (Corps) purchased 2300 acres of flood plain. From 1994 to 1997 the Corps planted the area with trees and grasses and now the Benedictine Bottoms is maintained by Kansas Wildlife and Parks. The purpose of our research is to determine reptile and amphibian biodiversity and to compare these results with a benchmark flood plain habitat at Fort Leavenworth, Kansas. Environmental factors which determine reptile and amphibian abundance and diversity are also being examined. The presence of each species was determined on a weekly basis during each species' activity period. Visual sightings and calls were used to determine the presence of the species. Population size estimates of the most common species were made using pitfall trapping and mark and recapture techniques. Population surveys (dependent upon activity periods of species) were conducted weekly. Results have revealed the presence of thirteen species of amphibians occurring on the Benedictine Bottoms. In 1999 the most abundant species encountered in pitfall traps on the Benedictine Bottoms was the western chorus frog. Ten reptile species have been observed on the Benedictine Bottoms. The two most abundant turtle species are the false map turtle and the slider. The

Benedictine Bottoms has 8 reptile species in common with the Fort Leavenworth benchmark. Three snake species and 5 turtle species, 2 reptile species are found on the Benedictine Bottoms that are not found at Fort Leavenworth.

Soil Microbial Biodiversity and Abundance on the Benedictine Bottoms Wildlife Mitigation Site

Jacqueline M. Bacon
Benedictine College, 1020 North Second Street, Atchison, KS 66002, 913-367-5340, c/o msimon@benedictine.edu

Co-authors: Bryan Adams, Crista Grasser, Lawrence Bradford, Martin P. Simon, Daniel Bowen, Benedictine Bottoms Missouri River Biodiversity Assessment Program, Biology Department, Benedictine College, Atchison, KS

In 1992 the U.S. Army Corps of Engineers purchased the Benedictine Bottoms to mitigate the loss of wetland habitats along the Missouri River. The Biology Department at Benedictine College studies the changes in biodiversity accompanying the mitigation process. Microorganisms play a key role in ecosystem dynamics on the bottoms. These organisms are crucial to various biogeochemical cycles such as soil nutrification.

Currently our goal is to continue research from previous years, namely, assessment of soil microbial biodiversity in the Benedictine Bottoms, and correlation of moisture levels to their abundance. During the past four years, soil samples were collected from various locations on the bottoms mitigation project. We continued to sample soil from various locations on the Benedictine Bottoms once a month at a depth of 5cm and 10cm. From those soil samples, the abundance and number of culturable bacterial taxa were determined and correlated with soil conditions such as pH, soil temperature, and air temperature.

Initial results show that a mean of 164×10^4 colony forming units (CFU) per gram of soil, with a range from 1.0×10^4 to 409×10^4 taken from samples diluted 10^{-3} through 10^{-5}. The results show that 67% of the culturable bacteria were gram negative while 33% were gram positive. The mean pH was 7.5, with a range from 7.2 to 8.1. The mean soil temperature was 13.5°C, with a range from 0.2°C to 28.5°C. Future plans include identifying microbial taxa present in the soil by polymerase chain reaction (PCR).

Use of Shallow-water Habitat by Larval Fishes in the Lower Missouri River

Kerry Reeves
University of Missouri, 302 Anheuser-Busch Building, School of Natural Resources, Columbia, MO 65211, 573-884-8534, KSR5G4@missouri.edu

Co-authors: Lori Patton and David Galat, University of Missouri, Columbia, MO

Scientists have recently recognized the value of larval fishes as indicators of ecological integrity. More precise data can be derived from larval fishes than from adult fishes due to their environmental sensitivity and limited mobility. We propose to characterize environmental conditions that define optimal nursery habitat for larval fishes in the lower Missouri River to aid habitat rehabilitation efforts. We are using a hierarchical approach to define nursery habitat with comparisons at the macro-scale (among main channel and

sandbar types), meso-scale (among locations within sandbar types), and micro-scale (0.25 m^2 grids within individual sandbar mesohabitats). Additionally, larval fish otoliths will be used to approximate time of spawning, growth rates, and time spent in the larval stage. Providing or restoring habitat that decreases time spent in the vulnerable larval stage can increase recruitment of a species or guild. We will define optimal nursery habitat for selected species using growth rates, species diversity and richness, and total abundance as indicators, and characterize it using current velocity, temperature, substrate, slope, sinuosity, and distance from shore. The U.S. Fish and Wildlife Service has recommended a goal of creating or restoring 20-30 acres of shallow water per mile in the lower Missouri River to provide habitat for native fishes. It is important to ensure that this habitat benefits fishes through their most vulnerable life stage.

Using Internet Information to Protect Water Quality in Missouri

Tabitha Madzura
University of Missouri-Columbia Outreach & Extension, 232 Agricultural Engineering Building, 573-882-0085, madzurat@missouri.edu

There is a critical need for information on the relative designs, plans, implementation and evaluation measures used to restore or rehabilitate water pollution sources. Working together with University Extension personnel, state, federal and non-governmental agencies, the Missouri Watershed Information Network (MoWIN) will plan and implement regional training workshops in Missouri. Workshops will include ways to find key elements for developing watershed restoration action strategies, source water protection plans, total maximum daily loads and water quality management plans. Target audiences will include landowners, land managers, locally led watershed alliances, decision and policy makers, educators, researchers, or volunteers. Pre-surveys will be conducted to determine the extent of watershed activities and/or education and information requirements. Project staff will work closely with the Department of Natural Resources, United States Department of Agriculture - Natural Resources Conservation Service and the Missouri Department of Conservation to determine watersheds where restoration activities may be necessary in future and include these during project implementation.

Using a watershed approach to restore the environment fosters a coordinated and efficient implementation effort of programs that reduce polluted runoff, protect natural resources and drinking water supplies. Providing information at a watershed level increases citizen accountability and involvement, as well as promotes a holistic way of managing watersheds. This project is an additional empowerment resource for Missourians to make informed watershed management decisions. The project will contribute to watershed restoration activities by promoting awareness of watershed-related information, educate citizens on how to access the various categories of information, and enhance participants' technological expertise. Hands-on activities will be provided to train participants to utilize existing information and data to develop watershed management plans. For additional information please visit: http://www.outreach.missouri.edu

BIO: Tabitha currently locates, accesses and compiles watershed-related information into MoWIN's website, edits, writes grant proposals, plans and implements project programs, writes publications, prepares and delivers conference/workshop presentations and manages the project web site.

PLENARY

Managing River Flows for Ecological Integrity

Brian Richter
Director, The Nature Conservancy Freshwater Initiative, 490 Westfield Road, Charlottesville, VA 22901, 804-295-6106, brichter@tnc.org

Monday
April 22

Morning
Sesson

Plenary

8:00 a.m. -
10:30 a.m.

Around the world, river scientists, conservationists, and water managers are now actively seeking ways to manage rivers to meet human demands for water while sustaining the ecological integrity of river ecosystems. Important advances are being made in the scientific, water management, and public policy aspects of "ecologically sustainable water management," and powerful new tools and approaches are becoming available. This presentation will highlight some of these advancements, beginning with a generalized adaptive management framework for the pursuit or implementation of ecologically sustainable water management. It will also highlight key scientific challenges, and some of the tools and methods that are being applied to address them.

BIO: Brian Richter is the Director of the Conservancy's Freshwater Initiative. He previously served as National Hydrologist during most of his 14 years with the Conservancy. His current responsibilities include serving as a liaison to public agencies, academic institutions, and other organizations involved in river conservation, and leadership of a staff that includes hydrologists, aquatic ecologists, educators and communicators. He works with scientists, conservationists, and local communities across the U.S. and internationally to identify strategies for meeting human needs for water while protecting river flows necessary to sustain healthy river ecosystems. He has published numerous scientific papers on the importance of ecologically sustainable water management, in journals such as *Conservation Biology, Ecological Applications, Freshwater Biology,* and *BioScience.*

Nebraska Game and Parks Commission

Gavins Point Dam • Yankton SD

Papers

Monday
April 22

Plenary

8:00 a.m. -
10:30 a.m.

Adaptive Management: Working the Water Management Conundrum

Steve Light
Institute for Agriculture and Trade Policy, 2105 1st Avenue, Minneapolis, MN 55404, 612-870-3474, stlight@iatp.org

The study by the National Research Council on the science and management of the Missouri River has created an opportunity for those seeking to improve Missouri River management something to rally around, to explore opportunities that reconfigure the institutions needed to support such a recovery. The question is will this effort be more of the same, something so novel as to be unrealistic or will those involved find a way to combine the best of the past with new approaches that will lead not just to biological recovery but to increased river basin resilience?

Dr. Light will address the fundamental pathology of natural resource management in the context of the Missouri River. He will discuss the deliberations and recommendations of the NRC study and the unprecedented opportunity that it appears to offer. He will also discuss the traps that people will undoubtedly, and unwittingly pursue that will lead back into the existing management conundrum. He will also offer some guidance based on his experiences in Yellowstone National Park, the Everglades, the Red River of the North and the Upper Mississippi River; guidance that will speak to resilience and how that must be pursued operationally if the people of the Missouri basin are sincere about their desire to recover the ecology of the basin.

BIO: Steve Light is the Director of the Center for Working Landscapes at the Institute for Agriculture and Trade Policy (IATP). The Center works to bring together diverse programs within IATP as well as outside organizations to pursue resilient solutions to ecological, social and economic problems that occur on scales larger than a single watershed. Before coming to IATP in 1999, Light spent five years with the Minnesota DNR on Upper Mississippi River and related watershed management issues, and before that, he spent twelve years in the Everglades as Policy Director for the South Florida Water Management District implementing adaptive management. He received his Ph.D. in 1983 from the University of Michigan's School of Natural Resources, where his studies emphasized ecosystem management and policy. Light serves on the National Research Council's panel reviewing the science and management of the Missouri River Basin, and was recently invited by the Committee on the Restoration of the Greater Everglades Ecosystem to review the Adaptive Assessment and Monitoring Program for the $8 billion Everglades restoration.

Information about the National Research Council report: *The Missouri River Ecosystem: Exploring the Prospect for Recovery* is available on the Missouri River InfoLINK web site - http://infolink.cr.usgs.gov

How Should We Proceed to Manage River Flows for Biodiversity?

David L. Galat
U. S. Geological Survey, Cooperative Research Units, 302 ABNR Building, University of Missouri-Columbia, MO 65211-7042, 573-882-9426, galatd@missouri.edu

Managing river flows for biodiversity is an emerging discipline within restoration ecology. Six steps are proposed to help accomplish flow restoration projects: (1) define criteria for success; (2) assess progress towards achieving criteria; (3) develop an ecological understanding of the system; (4) embrace uncertainty inherent in riverine systems; (5) get stakeholder buy-in for the project; (6) seek examples from other efforts to emulate. The first three of these are reviewed here.

Define Criteria for Success. Setting realistic objectives yields achievable results - avoid subjective endpoints. Too often broad, strategic program goals or policies are confused with specific, operational objectives. A key element in flow restoration projects is that desired ecological conditions be described in measurable terms. Ecological success can be defined relative to (1) reference conditions, and (2) predictions of biotic responses to hydrologic change. Reference conditions define biophysical changes that have occurred, provide end-points for success or starting points for recovery, and serve as mileposts for progress towards meeting ecological objectives. Vegetation and fish examples illustrate measurable predictions of biotic responses to hydrologic change.

Assess Progress. Ecological assessments should be (a) scale dependent and incorporate a *range* of indicators; (b) *results* driven - simple, relevant, measurable; (3) designed to assess progress towards achieving milestones and endpoints *not* monitor status and trends. Measuring what you need to be known, *not* what you know how to measure, is essential to results driven ecological assessments. Biological attributes should respond along the gradient of interest.

Develop Ecological Understanding of the biota's life-history traits and life-stage responses at taxonomic levels and scales that flow restoration is targeted to benefit. Examples are presented at the species (*Boltonia decurrens*, decurrent false-aster, federally threatened) and community levels (waterbirds as evaluation tools for Kissimmee River restoration).

Conclusion. Managing river flows to benefit biodiversity has a higher probability of success if a simple hierarchal framework is followed: Set ecological goals. Define measurable objectives. Conduct results driven ecological assessments. Meet project milestones. Achieve ecological endpoints. A flow chart illustrates how reference conditions, adaptive management feedback loops, and stakeholder input contribute to achieving ecological targets.

BIO: David Galat is Associate Professor of River Ecology with the U.S. Geological Survey Cooperative Research Unit at the University of Missouri, Columbia, Missouri. From 1984 – 1988, he was Assistant Professor with the Department of Zoology at Arizona State University. After receiving his Ph.D. from Colorado State University in 1982, Dr. Galat worked as an Assistant Research Professor and Leader of the Aquatic Ecology Group at the University of Nevada, Desert Research Institute. He received his B.S. from Cornell University and his M.S. from Colorado State University. Dr. Galat has published numerous reports on the Missouri River ecosystem and was a leader of the recently completed study, "Population Structure and Habitat Use of Benthic Fishes along the Missouri and Lower Yellowstone Rivers."

Papers

HABITAT REHABILITATION

Monday
April 21

Habitat Rehabilitation

11:00 a.m. - Noon

The Distribution of Conservation Lands on the Missouri River Valley Bottom, Sioux City, Iowa to St. Louis, Missouri

Mark S. Laustrup
U.S. Geological Survey, Columbia Environmental Research Center, 4200 New Haven Road, Columbia, MO 65201, 573-876-1831, mark_laustrup@usgs.gov

Since the Great Flood of 1993, the acquisition of flood prone lands has accelerated on the Missouri River. All purchases have been from willing sellers as the tracts come on the market. To date, there has been little effort to evaluate conservation land acquisitions in the context of their distribution and size throughout the valley bottom, Sioux City, Iowa to St. Louis, Missouri. The individual tracts purchased or leased to date are evaluated in terms of their contribution to the continuity of ecosystem function. This is especially important given the potential for substantial new acquisitions as part of the Expanded Mitigation Project. New acquisitions could be used to fill the "gaps" in the existing mosaic of habitat patches or beads.

In September 2001, geospatial datasets representing agency land holdings were collected from the Iowa Department of Natural Resources, the Missouri Department of Conservation, the Missouri Department of Natural Resources, the Nebraska Game and Parks Commission, the U.S. Army, Corps of Engineers, and the U.S. Fish and Wildlife Service. The Natural Resources Conservation Service provided WRP easements. All datasets were reprojected to an Albers Conic Equal Area projection and then clipped to the valley bottom. Ancillary layers used in this analysis include: the valley bottom, hydrography, roads, river miles, place names and shaded relief.

Descriptive statistics summarizing ownership by agency, size, location, density, and function are used to characterize the state of valley bottom acquisition. The application provides a geospatially explicit snapshot of rehabilitation efforts as of September 2001. The spatial decision support system, if maintained, would also allow state and federal land managers to evaluate potential purchases in the context of a tract's contribution to the reestablishment of a fully functional ecosystem.

BIO: Mark Laustrup is a geographer with 20 years of experience working on the application of remote sensing and GIS technologies to large river issues.

Iowa's Approach to Missouri River Mitigation Project Development

Ed Weiner
Iowa Department of Natural Resources, 22859 Filbert Ave., Onawa, IA 51040, 712-423-2426, Ed.Weiner@dnr.state.ia.us

Co-author: Carl Priebe, Iowa Department of Natural Resources' Riverton Wildlife Unit, Onawa, IA

Early river Projects designed to control flooding, stabilize banks, and establish navigation, altered the form and function of the Missouri River forever. Opportunities and methods of fish and wildlife mitigation change in a progression from the highly degraded upper stretch of the river to the agrading lower stretch of the Missouri River in Iowa. This program provides a visual survey of completed projects, planned projects and expansion opportunities for habitat restoration along the Iowa stretch of the altered Missouri River channel.

BIO: Ed Weiner is a Wildlife Management Biologist with the Iowa Department of Natural Resources' Missouri River Wildlife Unit. The Missouri River Unit operates 28 parcels of public land in Woodbury, Monona and Harrison Counties in Iowa. Three of these areas include fish and wildlife mitigation projects at Winnebago, Louisville, and California Bends. Co-author Carl Priebe is a Wildlife Management Biologist with the Iowa Department of Natural Resources' Riverton Wildlife Unit, managing public lands in Pottawatomie, Mills and Fremont Counties in Iowa.

Comparative Habitat Evaluations in Side-Channel Chute Rehabilitation Projects, Lower Missouri River

Robert B. Jacobson
U.S. Geological Survey, Columbia Environmental Research Center, 4200 New Haven Road, Columbia, MO 65201, 573-876-1844, robb_jacobson@usgs.gov

Co-authors: Mark S. Laustrup, Gary J. D'Urso, Joanna M. Reuter, and Harold E. Johnson, U.S. Geological Survey, Columbia Environmental Research Center, Columbia, MO

Numerous side-channel chutes have been constructed or are planned along the lower Missouri River. The purpose of these rehabilitation projects is to re-create some of the habitat diversity that existed before the river was extensively engineered. Performance of the projects has to be considered extremely uncertain: in addition to substantial biological uncertainty, physical habitat characteristics are unpredictable because of the inherently complex geomorphic and hydrologic dynamics of the river. Moreover, performance measures need to encompass diverse time frames to include seasonal to multi-year hydrologic variation, and multi-decadal time frames of geomorphic adjustments. We have developed several approaches to evaluate physical performance of side-channel chutes, including mapping of depth, velocity and substrate, airborne laser altimetry, conventional total station surveys, GPS mapping, and hydraulic modeling. Examples from Overton Bottoms Chute (RM 185-187), Lisbon Bottom Chute (RM 213-218), Cranberry Bend Chute (RM 280 – 281), and Hamburg Chute (RM 551 – 556) illustrate differences in chute characteristics and evaluation approaches.

BIO: Robb Jacobson has been with the USGS for 20 years researching surficial processes, hazards, and physical habitat with emphasis on the Ozarks and Missouri River for the past 10 years. He received a B.A. in Geology from Carleton College in 1979 and his Ph.D. from the Whiting School of Engineering at Johns Hopkins University in 1985.

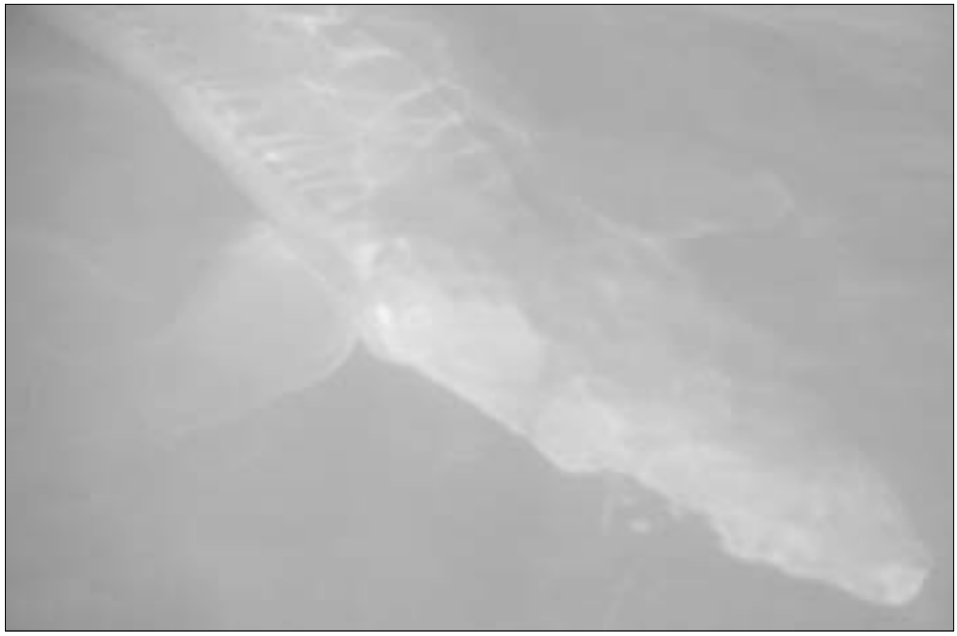
ENDANGERED SPECIES

Pallid Sturgeon: What We've Learned in the Last Decade

Steve Krentz
U.S. Fish and Wildlife Service, 3425 Miriam, Bismarck, ND 58501, 701-250-4419, Steven_Krenzt@fws.gov

Since 1990, when the pallid sturgeon *(Scaphirynchus albus)* was first listed as Endangered under the Endangered Species Act, the primary emphasis of the Recovery Program has been to implement recovery actions and increase our knowledge of the pallid sturgeon. The results of these studies allow us to make scientifically based recommendations for future recovery efforts. When the pallid sturgeon was identified as a separate species in 1905, very little information was available on the abundance or life history of this unique sturgeon. From 1905 to the early 1950's, there was very little emphasis placed on investigating this species. Beginning in the 1950's through the 1980's, increased curiosity and a better understanding of the effects human impacts have had on the big river fish began a journey that is continuing today. However, over the last decade, researchers have had an opportunity to shed considerable light on the biology and life history of the pallid sturgeon as well as other associated native riverine fish species. Although the quest for knowledge is never satisfied, the information gained over the last decade has been extremely valuable to begin recovery efforts and hopefully bring this species back from the brink of extinction.

BIO: Steve Krentz is the project leader for the U.S. Fish and Wildlife Service's Fish and Wildlife Management Assistance Office located in Bismarck, ND. Over the past 13 years, Steve has been working with the pallid sturgeon recovery program in various aspects from field data collection to currently serving as Recovery Team Leader.



Nebraska Game and Parks Commission

Pallid Sturgeon

The Corps of Engineers and the Biological Opinion: Opportunities for Pallid Sturgeon Recovery

Mark Drobish
Fisheries Biologist, U.S. Army Corps of Engineers, P.O. Box 710, Yankton, SD 57078, 402-667-2582, Mark.R.Drobish@usace.army.mil

The 2000 *Missouri River Biological Opinion* included the pallid sturgeon; the first formal consultation on the Missouri to include this species since it was listed in 1990. The Corps of Engineers has begun efforts to implement a Reasonable and Prudent Alternative that identified pallid sturgeon propagation/augmentation and population assessment as the cornerstones for pallid recovery. We intend to develop a propagation plan with several Missouri River Basin state and federal fish hatcheries to meet stocking goals annually. A comprehensive monitoring and evaluation plan is being prepared which will guide a standardized monitoring program for assessment of pallid sturgeon population status and trends throughout the Basin. Our intent is to partner with state and federal agencies and academic institutions throughout the Missouri River Basin in the development and subsequent implementation of this plan. Several agencies are currently conducting population assessment activities on the Missouri River following guidelines established in the "Pallid Sturgeon Population and Habitat Monitoring Plan for the Missouri and Kansas Rivers" (Draft 2001) for sampling from Ft. Randall Dam to St. Louis including the Kansas River. In 2002, with assistance from the Upper and Middle Basin Pallid Sturgeon Workgroups, this plan will be expanded to include the Missouri River from Ft. Peck Dam (Montana) to St. Louis, Missouri. The Corps of Engineers is committed to seeking new opportunities for pallid sturgeon recovery and population sustainability on the Missouri River.

BIO: Mark Drobish worked with the U.S. Fish and Wildlife Service for 15 years. In January, he took a new position as a fisheries biologist with the U.S. Army Corps of Engineer's Threatened and Endangered Species Program in Yankton, South Dakota.

Pallid and Shovelnose Sturgeon in the Lower Missouri and Middle Mississippi Rivers

Joanne Grady
U.S. Fish and Wildlife Service, 608 E. Cherry, Columbia, MO 65201, 573-876-1811, joanne_grady@fws.gov

Pallid sturgeon sampling was conducted by Nebraska Game & Parks Commission, Iowa Department of Natural Resources, U. S. Fish & Wildlife Service - Columbia Fishery Resources Office, Southern Illinois University, and Missouri Department of Conservation's Long Term Resource Monitoring Program station and Central Regional Office from November 1997 through April 2000. The cooperative project covered sections of 1000 river miles in the lower Missouri and middle Mississippi Rivers. Seven presumed wild origin pallid sturgeon and two recaptured hatchery fish were collected in the lower Missouri River. Seven hatchery origin pallid sturgeon were collected in the middle Mississippi River. The ratio of wild pallid sturgeon to all river sturgeon collected dropped from 1 in 398 (0.25%) in the late 1970s to 1 in 647 (0.15%). The contribution of hatchery raised fish can be seen when examining

the total number of pallid sturgeon collected. Wild and hatchery raised pallid sturgeon accounted for 1 in 247 (0.41%) of all river sturgeons. Seven pallid-shovelnose sturgeon hybrids were collected in the middle Mississippi River while 15 were collected in the lower Missouri River. The rate of hybridization increased from 1 in 365 (0.27%) river sturgeons in the late 1970s to 1 in 235 (0.42%) in the 1990s.

Pallid Sturgeon Propagation at the Gavins Point National Fish Hatchery

Herb Bollig
U.S. Fish and Wildlife Service, Gavins Point National Fish Hatchery, 31227 436th Ave., Yankton, SD 57078-6364, 605-665-3352, herb_bollig@fws.gov

The pallid sturgeon was determined by the U.S. Fish and Wildlife Service to be an endangered species and was provided federal protection on 9/6/90. A Pallid Sturgeon Recovery Plan was approved on 11/7/93, and a Pallid Sturgeon Propagation/Genetics Plan was completed on 1/22/92. The short-term goal of our efforts is to prevent extinction of the species in the wild. This goal may be possible only through propagation in hatcheries. Over the years many adult pallid sturgeon ranging in size from approximately 10 lbs. to over 60 lbs. have been held and spawned at the Gavins Point National Fish Hatchery. Handling and hauling guidelines have been written. Juvenile pallid and shovelnose sturgeon (and their hybrids) have been produced from adult spawning and have been reared with good growth and survival, achieving Length Increases/Month ranging to over 2.0 inches. Temperature Units/Inch Gain range between 30 and 50. Density and Flow Indices are very low. Both juveniles and adults are sensitive to the temperature regime used during intensive culture. Conversion ratios range between 1.5 and 3.0 in juveniles; and 3.0 to nearly 7.0 in subadults. Bacterial, fungal, and viral disease can be a very serious problem. Stocking of pallid sturgeon (and shovelnose) at various locations in the Missouri River and a couple of its larger tributaries has occurred nearly every year since 1995 with good results. The Gavins Point hatchery has worked with other "Species of Concern" native to the Missouri River in need of prelisting cultural activities, such as the blue sucker, sturgeon chub, flathead chub, paddlefish, and shovelnose sturgeon.

BIO: Herb Bollig has worked for the U.S. Fish and Wildlife Service for 25 years at seven different hatcheries in 6 states. He has managed Gavins Point National Fish Hatchery, Yankton, SD since 1991; prior to that he managed Erwin National Fish Hatchery, Erwin, Tennessee from 1989-1991. Herb received a Masters of Science from Kansas State University in Manhatten, KS and worked for the Kansas Wildlife and Parks after graduation for two years.

"Home Work" Fisherman Trains and B.F. Shaw

Capt. William (Bill) Beacom
Nav-Con Services, 2423 Jackson, Sioux City, IA, 712-255-3412,
bbeacom@pionet.net

Is science an ongoing evaluation and organization of current knowledge and historical information, or an avenue for unsubstantiated posturing to further agendas? This presentation will be a closer look at the known history of that part of the Missouri River Basin that includes Northwestern Iowa, the Eastern Dakotas and South Western Minnesota, from 1804 to the present. It will take a historical look at the native and introduced fishes of this area, and when and how the introduced species got there.

BIO: Bill Beacom was a Missouri River Captain for 45 years. He has made presentations at SNAME ship controllability meeting No.97 Silver Springs MD, "*Missouri River"* Washington D.C. Smithsonian Folk Life Festival June 26-30 & July 3-7 1996, "Missouri River" Iowa Sesquicentennial Des Moines, IA Aug 22-25 1996, and Riverine Biodiversity Conference, University of Colorado July 2001. He was a featured speaker on Missouri River Environmental Issues MARC 2000 Annual Meeting and is the Navigation Industry Representative on Environmental Issues.

Habitat Use and Movement of Juvenile Pallid Sturgeon in the Missouri River

Wayne Stancill
U.S. Fish and Wildlife Service, 420 S. Garfield, Pierre, SD 57501-5409, 605-224-8693, wayne_stancill@fws.gov

Co-author: George Jordan, US Fish and Wildlife Service, Billings, MT

Pallid sturgeon were listed as endangered in 1990 by the U.S. Fish and Wildlife Service. Previous work identified limited recruitment as one of the primary factors leading to the decline of pallid sturgeon in the impounded sections of the Missouri River above Gavins Point Dam and identifying early life history information is a critical element in their recovery. In the spring of 2000, 50 juvenile pallid sturgeon propagated at the Gavins Point National Fish Hatchery and six adults were surgically implanted with sonic transmitters and released into the Missouri River between Ft. Randall and Gavins Point Dams. Since their release, we have intensively and extensively relocated the fish twice per month by boat. At each site, a GPS location was recorded with habitat information for future delineation of movement patterns and habitat preferences using Geographic Information System (GIS). Juvenile pallid sturgeon exhibited definite season migration patterns and preferred habitats.

BIO: Wayne Stancill is the supervisor for the U.S. Fish & Wildlife Service, Great Plains Fisheries Resource Office in Pierre, South Dakota.

Papers

Monday, April 22

Concurrent Session 1

Endangered Species

1:30 p.m. - 5:00 p.m.

Least Tern and Piping Plover Response to the 1997 Flood Event on the Missouri River

Gregory A. Pavelka
U.S. Army Corps of Engineers, P.O. Box 710, Yankton, SD 57078, 402-667-7873, gregory.a.pavelka@usace.army.mil

The interior least tern and the northern Great Plains population of the piping plover were listed as endangered and threatened respectively in 1986. These shorebird species utilize the Missouri River for breeding and as a migration corridor. In 1997, record runoff in the Missouri River Basin necessitated high releases from the dams on the Missouri. These releases caused an artificial flood event on the Missouri that had not been seen since 1975. This paper examines least tern and piping plover productivity before and after 1997 on three reaches of the river, the Missouri below Fort Randall Dam, Lewis & Clark Lake and the Missouri below Gavins Point Dam. The results show, post 1997, an initial significant increase in productivity and adult numbers for both species on all three reaches followed by declining productivity and overall numbers. The importance of this data is that it shows both species respond positively to artificial flood events and that increases in releases from the dams in the future could be used to reproduce these results.

BIO: Greg Pavelka is a wildlife biologist with the U.S. Army Corps of Engineers stationed at the Gavins Point Project. He has spent the last six years working on least tern and piping plover recovery.

Emergent Sandbar Habitat Trends below Gavins Point Dam

Bruce A. Vander Lee
U.S. Army Corps of Engineers, P.O. Box 710, Yankton, SD 57078, 402-667-7873, bruce.a.vanderlee@usace.army.mil

The Missouri River between Gavins Point Dam and Ponca, NE is an important area for threatened piping plovers and endangered least terns, which utilize emergent sandbars for nesting and brood rearing. We monitored and analyzed emergent sandbar habitat below Gavins Point Dam from 1996 – 2000 to assess habitat conditions prior to and following the high water event of 1997. Sandbar acreage increased 4-5 fold from 1996 to 1998. The created sandbars were lightly vegetated and often occurred in complexes of sandbars rather than single large sandbars. From 1998-2000, vegetation encroachment and erosion reduced available nesting habitat. However, habitat conditions remain better than pre-1997 conditions. Piping plover and least tern productivity has mirrored observed habitat trends, with significant increases from 1996-1998 and continuing high productivity into 2001. Our results show the importance of enhanced habitat conditions for piping plover and least terns productivity on this stretch of river and the potential value of flows in meeting the recovery need of these species.

BIO: Bruce Vander Lee is a Consultant working with the Corps of Engineers on habitat issues for endangered species on the Missouri River.

Least Tern and Piping Plover Captive Rearing Program - A Review and Update

Rosemary A. Vander Lee
U.S. Army Corps of Engineers, P.O. Box 710, Yankton, SD 57078, 402-667-7873, rosemary.a.vanderlee@usace.army.mil

Since 1995, the U.S. Army Corps of Engineers and U.S. Fish and Wildlife Service have conducted a captive rearing program for endangered least tern and threatened piping plover eggs salvaged from the Missouri River. Working cooperatively with zoos, captive rearing specialists, and biologists, the Corps has developed protocols for successfully raising least tern and piping plover chicks and returning them to the wild. During the past seven years, the Corps has collected 565 piping plover and 447 least tern eggs, of these over 80% hatched successfully. Over 420 (92%) piping plovers and 300 (82%) least terns have been released back to the Missouri River. In addition to aiding recovery goals, the captive rearing program has produced important scientific information about these species not readily obtainable in the wild, and established recovery partnerships with other agencies and the zoo community.

BIO: Rosemary Vander Lee has been with the Corps of Engineers for 3 years and manages the Corps' Captive Rearing Facilities at Gavins Point Project in Yankton SD

Interior Least Tern
Nebraska Game and Parks Commission

Monday, April 22

Concurrent Session 2

Hydrology • Geo-morphology • Water Quality

1:30 p.m. - 5:00 p.m.

Fish Spawning and Discharge–Temperature Coupling along the Missouri River

David L. Galat
U. S. Geological Survey, Cooperative Research Units, 302 ABNR Building, University of Missouri, Columbia, Missouri 65211-7240; galatd@missouri.edu.

Co-author: Sandra J. Clark, Department of Fisheries and Wildlife Sciences, University of Missouri Columbia, MO

The flood-pulse concept predicts that ideal conditions for fish spawning occur in years when the spring flood and temperature rise are coupled. We evaluated long-term discharge and temperature patterns in the upper Missouri River (Bismarck, North Dakota – 121 km below Garrison Dam) and the lower Missouri River (Boonville, Missouri – 988 km below Gavins Point Dam) before (1939-1955) and after (1967-2000) impoundment and related their timing and duration to spawning periods of major fishes. Discharge and temperature are now decoupled at Bismarck. Median daily discharge is now 841 cms and occurs in February, whereas before regulation it was 1,351 cms and occurred in June. Median daily temperature historically peaked at 25.6 C in late July and now peaks at 16.7 C. The formerly bimodal median daily discharge at Boonville is now more unimodal, median maximum discharge has decreased by 40%, and timing is earlier than historically. Coupling of discharge and temperature is still present for the April rise at Boonville, but decoupled for the June flood pulse.

The Missouri River basin supports 183 fish species and 99 reside in the main stem river. Eighty-two percent of Missouri River's fishes begin spawning between 9 and 22 C with a modal temperature of 16 C. Prior to flow regulation, initiation of fish spawning coincided with rises in discharge and temperature for the June pulse at Bismarck and April and June pulses at Boonville. There is no longer a flood pulse associated with temperatures at which most fish spawning begins at Bismarck. A temperature of 9 C is now reached on average 20 days later at Bismarck, and 16 C is reached >1 month later. A temperature of 22 C is generally no longer present at Bismarck. Theoretically, water temperatures never get high enough at present for ~40% of Missouri River fishes to spawn between Garrison Dam and Bismarck. Spawning initiation by fishes between 9 and 16 C is presently coupled with the earlier spring flow pulse at Boonville. However, discharge is generally no longer increasing for the 55% of fish species that begin spawning at temperatures ≥16C. Historically, Missouri River temperature and discharge rises coincided with temperatures at which most fishes spawned. The discharge cue is absent today at Bismarck and minimal spawning temperatures are not reached for some species (e.g., sicklefin and sturgeon chubs). The June discharge cue has been altered for some fishes at Boonville. Recommendations for modified flows and temperatures in the Missouri River should consider that discharge and temperature patterns are closely coupled in a normative river and that timing of fish spawning is integrated with these patterns.

BIO: See page 31

Long-Term Stage Trends on the Lower Missouri River Based on an Empirical Hydrologic Analysis

Reuben A Heine
Southern Illinois University, Environmental Resources and Policy, Mailcode 4637, Carbondale, IL 62901-4637, 618-453-7384, rheine@siu.edu

Co-author: Nicholas Pinter, Department of Geology, Southern Illinois University, Carbondale, IL

The purpose of this research was to document long-term trends in flow conveyance on the Lower Missouri River (LMoR), attempt to explain what mechanisms have caused these trends, and to update flood frequencies using the new "stage indexing" technique. We analyzed stage and cross-sectional measurements for five LMoR gaging stations located at St. Joe, Kansas City, Waverly, Boonville, and Hermann. In general, very different behavior was documented at high discharge vs. low discharge conditions. For the lowest flows (except at Waverly), the associated stages trended systematically downward as a result of channel incision. Conversely, for the larger discharges, the opposite pattern was observed – at all stations the associated stages rose over the period of record by as much as 6 feet.

Rising flood stage trends imply that large floods will occur more frequently than previously estimated. The 'stage indexing' technique updates flood frequencies by indexing the stage data to the current year, thereby statistically normalizing the data and thus removing the systematic trend. Using indexing, estimated frequencies for all flood events at all five stations analyzed were increased, sometimes dramatically. For example at Boonville, the largest flood occurring in the 70-year record was the 1993 flood with a stage of 35.16 ft. Without accounting for the long-term shifts, this #1 ranked flood would have at least a recurrence interval of 71 years. However, after indexing, the 1993 flood drops to the #4 rank and the adjusted recurrence interval for a stage of 35.16 ft is dropped to ~15 years under present-day conditions.

BIO: Reuben Heine is this year's Association of State Flood Plain Managers Graduate Fellow and is a first year Ph.D. student in the Environmental Resources and Policy Program at Southern Illinois University. He received a M.S. from the Department of Geography at Southern Illinois University. His background and interests are in hydrology and geographic information systems.

Determination of the Natural Flow Regime of the Missouri River Below Gavins Point Dam

Roger Kay
U.S. Army Corps of Engineers, Omaha District, 106 South 15th Street, Omaha, NE 68102, 402-221-3150, Roger.L.Kay@usace.army.mil

Discharge-frequency relationships for the Missouri River below Gavins Point were developed nearly 40 years ago, prior to full regulation of the Missouri River. In order to develop new discharge-frequency relationships, daily flow hydrographs were developed for both natural and regulated flow conditions over a 100-year period by means of model studies, developing a homogenous record for both flow conditions. Due to extensive water resources development in the Missouri River basin, consider-

able effort went into developing the natural flow record. Natural flows were estimated by adjusting the observed flow record by estimations of water resource development, such as irrigation depletions, reservoir regulation, evaporation from reservoirs and other consumptive water uses. This led to the development of a more comprehensive estimation of the natural flow hydrograph than previous studies. Mean annual and monthly discharges were derived from the flow record, as well as peak annual flows. Statistical analyses were performed on the various flow parameters and comparisons were made on the natural flow regime over various time periods. Results of the study show significant differences in the natural flow regime over several periods of time. Results also show differences in the natural flow hydrograph along the river due to watershed and climatic effects. The impacts of irrigation withdrawals and reservoir regulation on the natural flow hydrograph were also determined.

BIO: Roger Kay is a graduate of Iowa State University in Agricultural Engineering and has worked for the Corps of Engineers since 1990. He is a hydraulic engineer, serving as technical specialist in hydrology.

Use of Stream-Gage Information to Assess Changes in River-Channel Morphology

Kyle E. Juracek, U.S. Geological Survey, 4821 Quail Crest Place, Lawrence, KS 66049-3839, 785-832-3527, kjuracek@usgs.gov

An understanding of the response of a river channel to natural and human-caused changes is important for several reasons including the protection of property and structures, the protection and rehabilitation of aquatic and riparian habitats, and improved water quality. Changes in channel morphology may be assessed using information available from the U.S. Geological Survey (USGS) national network of stream-gaging stations. The gaging stations provide long-term, site-specific information that may be indicative of channel conditions both upstream and downstream of the stations. Stream-gage information may be used to determine changes in stage-discharge relations, channel-bed elevation, channel width, channel area, and flow velocity.

The changes may be assessed in terms of magnitude, timing, trend, and rate. Recent USGS studies in Kansas have used stream-gage information, by itself or in combination with other types of information (for example, aerial photography), to investigate the response of river channels to reservoirs and channelization. One study determined that, contrary to popular perception, a river had not widened substantially in response to changes imposed by an upstream dam. Results of a second study indicated that channel-bed degradation downstream from large Federal reservoirs throughout Kansas ranged from less than 1 to about 9 feet. In a third study, it was determined that channel-bed degradation mostly due to channelization had migrated at least 12 miles upstream at a rate of about 1 mile per year. Stream-gage information can be effectively used to quantify changes in channel morphology, infer the causes of the changes, and possibly estimate future channel changes.

BIO: Kyle E. Juracek is a Hydrologist. He has a Ph.D. in Geography from University of Kansas. Research interests include fluvial geomorphology, reservoir sediment deposition and quality, and the application of GIS and remote sensing to address water-resources issues.

Hydrological Effects of a Constructed Chute on Wetland Stage and Ground-Water Levels in the Missouri River Flood Plain at Overton Bottoms, Missouri

Brian P. Kelly
U.S. Geological Survey, 301 West Lexington, Independence, MO 64050, 816-254-2942, bkelly@usgs.gov

Channelization of the lower Missouri River flood plain has straightened and narrowed the river reducing both wetland creation and the value of the flood plain to fish and wildlife. Efforts to mitigate the effects of management of the lower Missouri River have reconnected marginal and wetland habitats to the main channel. One of the tracts of land acquired for this purpose is Overton Bottoms in central Missouri where a newly constructed chute has reconnected the flood plain with the river. Previous studies about interactions between river stage, wetland stage, ground-water levels, and rainfall at Overton Bottoms before the chute was constructed indicate shallow wetland hydroperiods were most affected by rainfall and flood inundation while deeper wetlands and scours were most affected by ground-water fluctuations caused by river-stage changes. These data provide an excellent baseline to evaluate changes in hydrology caused by chute construction. At Overton Bottoms, it is likely that chute construction will lower the water table surface near the chute and decrease the areal extent or "wetness" of nearby wetlands. At the same time the fluctuation of stage within the chute may increase the variability of the water table and the frequency of inundation and increase the amount and variability of nearby wetland habitat. To date, the effects of chute construction at mitigation sites have gone largely uncharacterized. The Overton Bottoms reach provides an ideal opportunity to evaluate hydrologic effects of this rehabilitation design by comparing hydrologic functions in a variety of wetland types before and after chute construction.

BIO: Brian is a hydrologist with the USGS in Independence, Missouri. Research interests include ground-water modeling and the interaction of surface water and ground water in large river systems. He has conducted research on Missouri River flood plain hydrology since 1991.

A Whole-Lake Water Quality Survey of Lake Oahe Based on a Spatially-Balanced Probabilistic Design

David W. Bolgrien
U.S. EPA, Mid-Continent Ecology Division, 6201 Congdon, Duluth, MN 55804, 218-529-5216, bolgrien.dave@epa.gov

Co-authors: T. R. Angradi and E.W. Schwieger, U.S. Environmental Protection Agency, Mid-Continent Ecology Division, Denver, CO; T.D. Corry, S.E. Miller, G.S. Peterson, J.V. Scharold, C.W. West, and J.R. Kelly, U.S. Environmental Protection Agency, Mid-Continent Ecology Division, Duluth MN

Assessing conditions on large bodies of water presents multiple statistical and logistical challenges. As part of the Upper Missouri River Program of the Environmental Monitoring and Assessment Project (EMAP) we surveyed water quality of Lake Oahe in July-August, 2001 using a spatially-balanced probabilistic design. A

total of 51 sites were distributed throughout the reservoir with 36 sites in bays and 15 sites in the nominal open-water. Although bays comprise only 28% of the area of the reservoir, a disproportionate number of bays sites was designed to sample the more variable conditions in bays. Twelve of the bay sites were placed in the confluence areas of the Cheyenne, Grand, and Moreau Rivers. The EMAP design permits data collected at a small number of sites to be extrapolated with known statistical confidence to the entire reservoir. Water quality variables measured included turbidity, chlorophyll, conductivity, light attenuation, total phosphorous, nitrogen (total, nitrate+nitrite, ammonia), silica, total organic carbon, total suspended solids, and a suite of anions and cations. Preliminary results suggest that trophic status in Lake Oahe increases from south to north. Measured chlorophyll concentrations ranging from 0.8 ug/L near Oahe Dam to 9.7 ug/L near the delta. Further analyses will reveal the cumulative area of the reservoir possessing a given range of values for each water quality variable. Compared to traditional sampling programs, the EMAP strategy increases the capacity to conduct large-scale assessments because fewer sampling locations are needed to make statistically defensible statements about extensive resources. This abstract does not necessarily reflect EPA policy.

BIO: David Bolgrien is a research biologist at the Mid-Continental Division of the EPA's Office of Research and Development in Duluth MN. His Ph.D. research at the University of Wisconsin-Milwaukee focused on the limnology of large lakes such as Lake Michigan, Lake Superior, and Lake Baikal. He is happy now to have the opportunity to study the Great Lakes of the Upper Missouri.

Bad River Phase II Water Quality Project — A Success Story

Jerry Thelen
Stanley County Conservation District/Bad River Water Quality Project, P.O. Box 98, Fort Pierre, SD 57532, 605-223-2253, brjerry@dakota2k.net

The Bad River is one of four major watersheds that drain into the Missouri River in South Dakota that are almost entirely made up of highly erodible croplands and fragile, clayey rangelands. The watershed is 3,107 sq. mi. (1,988,480 ac.) in size. The Bad River empties into the Missouri River five miles downstream from the Oahe Dam into Lake Sharpe reservoir between the towns of Fort Pierre and Pierre.

Sediment from the Bad River became a major concern in the mid-1980's. It was determined that if sedimentation continued at the current unacceptable rates, storage in the Missouri River mainstem dams would be prematurely depleted and all beneficial uses would be impaired. Hydropower generation and recreation have been impaired. Raised bed elevation led to flooding in Fort Pierre and Pierre.

In 1989, the Bad River Phase I Project began. Its goal was to identify the major sources of sediment that were entering the Bad River. As a result of the Study, 1n 1990 the Bad River Phase II Water Quality Project was developed and begun. It was targeted to an 183,000 ac. sub-watershed of the Bad River in Stanley County, South Dakota. One concern was the willingness of the landowners to become involved in the project.

There was apprehension on their part concerning the possible loss of landowner rights if they became involved with the project. The major goals of the project were to determine and apply cost effective land treatments that provide long lasting erosion control and reduction in sediment load without jeopardizing the financial viability of the cooperating landowners. (See picture, page 25.)

BIO: Jerry Thelen has been the Bad River Water Quality Project Coordinator since Phase II began 11 years ago. Before that he was a manufacturing engineer, teacher and Cooperative Extension Service County Agent.

USGS

Delta formed at the headwaters of Lewis and Clark Lake from Niobrara River sediment.

Reservoir Sedimentation – A Time For Action

Howard Paul
Missouri Sedimentation Action Coalition, P.O. Box 1253, Pierre, SD 57501, 605-773-7341, kevin.king@ci.pierre.sd.us

The six Missouri River mainstem reservoirs serve many functions, including flood control, hydropower production, recreation, public water supply and irrigation. However, these reservoirs are being threatened by sedimentation. Silt carried by tributaries and bank and bed erosion in those limited areas of free flowing river settles out when it reaches the still waters of the reservoirs. This accumulation of sediment has reached major proportions in Lewis and Clark Lake (Gavins Point Dam Reservoir). The Corps of Engineers has publicly stated that that reservoir will be completely silted in in less than 75 years. Accumulation of Bad River sediment in Lake Sharpe at Pierre/Fort Pierre, South Dakota, has resulted in reduced peak power production capabilities from Oahe Dam at certain times. The Bad River deposits 3500 acre-feet per year into Lake Sharpe. A similar situation is developing at Bismarck, North Dakota, where bank and bed erosion from Garrison Dam to the top end of Oahe Reservoir deposits 684 acre-feet per year. Other major tributaries such as the White River and Cheyenne River are causing problems. Recreation is severely affected, as are power production and public water system and irrigation intakes, as

well as rising groundwater tables affecting homes and businesses, agriculture and trees. The situation is serious.

The Missouri Sedimentation Action Coalition (MSAC) has been formed to focus congressional attention and funding on this issue. MSAC is intended to be a multi-state, multi-interest organization, which can generate the political clout to achieve that goal.

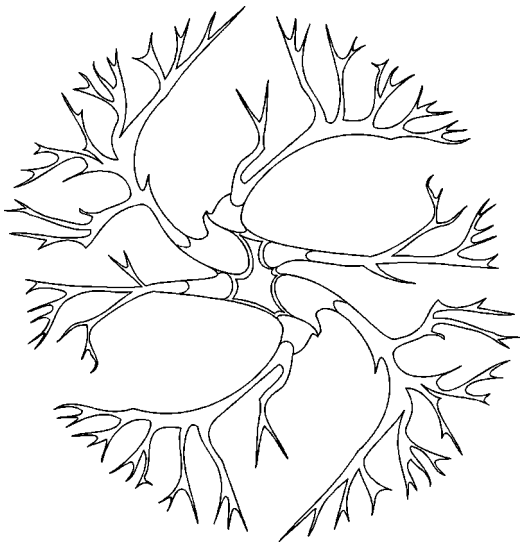
BIO: Howard Paul is retired from SPN & Assoc. Consulting Engineers, Mitchell, South Dakota where he worked for 38 years in water resources and wastewater reclamation. He has a B.S. in Civil Engineering from ND State University (1956). He is a Professional Engineer and Land Surveyor.

Missouri River Interstate Water Quality – TMDL Concerns

Sharon Clifford
Missouri Department of Natural Resources, Water Pollution Control Program, P.O. Box 176, Jefferson City, MO 65102, 573-751-7298, nrclifs@mail.dnr.state.mo.us

Water Quality Standards and Total Maximum Daily Loads (TMDLs) are driving all water quality issues from permitting to nonpoint source funding. EPA is working toward uniformity in Water Quality Standards between states. They are also modifying the guidance and rules related to TMDLs, so that listings of impaired waters and the resulting TMDLs also are more consistent. When comparing the 1998 303(d) lists from states in the Missouri and Mississippi basins the discrepancies are glaring. One example is Nebraska where the lower section of the Missouri River is listed for fecal coliform impairment, but Missouri has it listed for habitat impairment. These discrepancies occur for several reasons including differences between state water quality standards and different data sets used for their assessments. The session will discuss the problems and possible solutions.

BIO: Sharon Clifford is the TMDL Coordinator for the Missouri Department of Natural Resources. For six years prior to this, Sharon was DNR Coordinator of the Missouri Stream Team Program where she developed and implemented the Missouri Volunteer Water Quality Monitoring Program. Sharon started with DNR as a state-wide Field Services water quality monitor where she managed the effluent toxicity-testing program. She received a degree in Education from the University of Missouri-Columbia.



Fishes and Habitat of the National Recreational River Segments of the Missouri River in South Dakota

Charles R. Berry Jr.
USGS Cooperative Research Unit and South Dakota State University, Box 2140b, Brookings, SD 57007, 605-688-6121, charles_berry@sdstate.edu

Co-author: Bradley A. Young, USGS Cooperative Research Unit and South Dakota State University, Brookings, SD

Berry and Ph.D. student Bradley Young focused on two South Dakota portions of the Missouri River, which are both in the National Recreational River Program. Two reaches of the Missouri River in South Dakota are part of the National Recreational River System - - the 59-mile section of the river below Gavins Point Dam and the 39 mile section from Fort Randall Dam to the head of Lewis and Clark Lake. There has never been a thorough inventory of the fish community in these reaches. We collected fish during three summers (1996-1998) from six macro habitats (channel crossovers, inside bends, outside bends, secondary channels connected to the river, secondary channels not connected to the river, tributary mouths) using five gears (experimental gill net, drifting trammel net, trawl, electrofisher, and seine). Over the three sampling periods, we handled 22,769 fish. Excluding hybrids and unidentifiable age-0 fish, we collected 4,042 fish of 42 species in 1996, 8,377 fish of 47 species in 1997 and 5,850 fish of 45 species in 1998. Nine species were unique to the Gavins Point reach (i.e. blue sucker, sicklefin chub, western silvery minnow, bigmouth shiner, grass carp, green pickeerel, highfin carpsucker, longnose gar, and orangespotted sunfish), whereas 2 species were unique to the Fort Randall reach. Numerically dominant species in both reaches 1996 were emerald shiner (52%), gizzard shad (16%), river carpsucker (5%), and sand shiner (3%); whereas in 1997, species comprising more than 3% of the total catch were gizzard shad (39%), emerald shiner (19%), quillback (8%), spotfin shiner (7%), and sand shiner (3%). Common recreational species included channel, blue, and flathead catfish, walleye, sauger, drum, smallmouth and largemouth bass, white crappie, northern pike, and yellow perch. Introduced species were grass carp, rainbow smelt, and white bass. Species thought to be rare included shovelnose sturgeon and sicklefin chub. Combined with data from routine fisheries monitoring done by the South Dakota Department of Game, Fish and Parks and the Nebraska Game and Parks Department, these data will help the National Park Service implement management plans with full consideration for conserving and enhancing fishery resources.

BIO: Charles Berry has been the Leader of the South Dakota Cooperative Fish and Wildlife Research Unit for 17 years. He was one investigator in the benthic fishes study of the Missouri River, which was a joint study among 6 Universities, 6 Coop Units, the USGS Columbia Environmental Research Center, and the Montana Department of Game and Fish.

Fish Population Dynamics of Hamburg Bend

Steve Freeling
Nebraska Game and Parks Commission, 2200 North 33rd Street, Lincoln, NE 68503, 402-471-5447

Co-authors: Gerald Mestl and Jason Skold, Nebraska Game and Parks Commission, Lincoln, NE

Hamburg Bend is Nebraska's first habitat restoration project as part of the Missouri River Fish and Wildlife Mitigation Project. Hamburg Bend covers approximately 1630 acres consisting of terrestrial flood plain habitat and a free-flowing chute approximately 2.5 miles in length. Construction of the chute began in January 1996 and was completed in May 1996. The chute was sampled using seines and other methods as part of the monitoring program.

Seining is done seasonally, spring, summer, and fall. In the first years after construction, the catch per seine haul of speckled chubs and silver chubs was several times higher than found in the adjacent river in the late 1980's and early 1990's and nearly as high as in the early 1970's. Flathead chubs, which were seldom seen in the adjacent river in the 1986-1993-time period, were regularly sampled and plains minnows were sampled at twice the abundance seen in the early 1970's. After the high water in 1996 and 1997, we have observed a decrease in the numbers of these species.

BIO: Steve Freeling graduated from University of Nebraska at Lincoln with a B.S. in Fisheries and Wildlife in 1998. He worked for the Nebraska Department of Environmental Quality as a Lab/Field technician for two summers in 1998 and 1999 and started with the Nebraska Game and Parks Commission in 1999 as a conservation technician. Steve is currently a biologist working on the Missouri River Mitigation Site monitoring project.

Fish Community Monitoring at Lisbon Bottom, a Restoration Area on the Lower Missouri River

Louise Mauldin
U.S. Fish and Wildlife Service, 608 E. Cherry, Columbia, MO 65201, 573-876-1911, louise_maudlin@fws.gov

Prior to development of the river, chutes and sloughs were an important component of the Missouri River ecosystem providing diverse off-channel habitat for fish and wildlife. Fish community response was monitored in Lisbon Chute, a naturally formed side channel from 1997 to 2001. The chute is part of Lisbon Bottom, a restoration unit of the Big Muddy National Fish and Wildlife Refuge. It was the first naturally formed side channel on the lower Missouri River since the river was developed. Species composition, species richness, species diversity, and relative abundance were compared across four general aquatic areas from RM213 to RM219. Habitat use by selected native species was also characterized. Thirteen sites were established across Lisbon chute, 3 smaller chutes, a sandbar-wing dike complex, and main channel. Multiple gears were used to assess the fish community. In the six-year period, 67 species representing 17 families were documented at Lisbon Bottom. Mean species richness was highest in Lisbon Chute and was significantly different across

the four areas sampled ($p<0.0001$) and across years ($p<0.0001$). Mean species diversity was greater in the chute from 1997 to 1999 and in the main channel in 2000 and 2001. Species diversity was significantly different across areas ($p<0.0001$) and across years ($p<0.0001$). Diverse habitat within Lisbon Chute provided refugia for numerous young-of-the-year (YOY) species including three YOY pallid sturgeon in 1998 and 1999. This was the first documented evidence of pallid sturgeon reproduction in the lower Missouri River.

BIO: Louise Mauldin is currently a fishery biologist for the U.S. Fish and Wildlife Service in Columbia, Missouri. She has a B.S. in Fisheries and Wildlife Biology (1989) and a M.S. in Fisheries Biology (1999) both from Iowa State University in Ames, Iowa.

Effects of Woody Corridors on Levee Damage in the Flood of 1993

Stephen B. Allen
School of Natural Resources, University of Missouri-Columbia, 203 Anheuser-Busch Natural Resources Building, Columbia, MO 65211, 573-882-6074, sba67c@mizzou.edu

Co-authors: John P. Dwyer, David R. Larsen, Douglas Wallace, Elizabeth A. Cook, University of Missouri-Columbia, Columbia, MO

This study investigated levee damage along the 353-mile long segment of the Missouri River between the confluence with the Mississippi River (River Mile 0) and River Mile 353 near Independence, Missouri during the Flood of 1993. Results indicate that woody riparian corridors between the riverbanks and primary protective levees play a significant role in the prevention and reduction of flood-related damage to levees. Forty-one percent of the levee failures in this segment occurred where no woody corridor was present, while 74% percent of all breaks occurred where woody corridor widths were <300 feet and 83% occurred where woody corridor widths were <500 feet. Median break lengths with a woody corridor present were 50.3% shorter than median break lengths with no woody corridor present. Levees without failures had significantly wider median woody corridor widths than levees that did fail. Eligibility for the Corps of Engineers levee maintenance program was not a significant factor in reduction of levee damage. Discontinuities in woody corridors played a role in 27.5% of the levee failures in the study segment. Smaller segments based on geomorphic differences in the river valley were studied to determine if these differences influenced the value of woody corridors in levee damage reduction.

BIO: Stephen Allen is a graduate student in the School of Natural Resources at the University of Missouri-Columbia.

Papers

Wednesday, April 24

Concurrent Session 1

Biological Resources Trends • Habitat Relationships

8:30 a.m. - Noon

Sources of Spatial Variation in Shoreline-Associated Large Woody Debris in the Garrison Reach of the Upper Missouri River

Ted Angradi
U.S. Environmental Protection Agency, Office of Research and Development, Mid-Continent Ecology Division, 999 18th Street, Suite 300, Denver, CO 80202, 303-312-6575, angradi.theodore@epa.gov

Co-authors: David Bolgrien, U.S. Environmental Protection Agency, Office of Research and Development, Mid-Continent Ecology Division, Duluth, MN; E. William Schweiger, U.S. Environmental Protection Agency, Office of Research and Development, Mid-Continent Ecology Division, Denver, CO; Tony Selle and Peter Ismert, U.S. Environmental Protection Agency, Region 8, Denver, CO

Large woody debris (LWD) recruited to the river channel has an important structural and functional role in large river ecosystems including the Upper Missouri River. The amount and distribution of LWD in a reach of river influence fish and invertebrate habitat suitability and can reveal local and landscape-level influences on river ecology including effects of land use and shoreline modification on LWD recruitment and retention. In summer 2001, we completed a survey of all shoreline-associated LWD in the Garrison Reach of the Missouri River in North Dakota. We collected GPS coordinates of all LWD within 10 m of the bank and of all shoreline modifications (blanket revetments, jetties, hard points, etc.). We noted the disposition of all LWD (beached, deep, shallow, etc,) and the shoreline development adjacent to each piece of LWD (forest, range, industrial, etc). We will (1) determine the amount and longitudinal variation in LWD and shoreline modification in the Garrison Reach, and (2) examine associations among shoreline modifications, riparian land use, and LWD. One of our goals is an understanding of how flood plain and riparian management can influence channel processes in a reach in which the aquatic ecosystem is largely detached from the floodplain by flow regulation. Our findings will enhance our ability to evaluate the ecological effects of current and future shoreline modification projects and flood plain development in the Garrison Reach. This project is part of the Upper Missouri River Pilot Project of the Environmental Monitoring and Assessment Project. This abstract does not necessarily reflect EPA policy.

BIO: Ted Angradi is an aquatic ecologist and a co-PI in the Upper Missouri River EMAP pilot project.

Landscape Structure and Composition in the Garrison Reach of the Upper Missouri River

E. William Schweiger
U.S. Environmental Protection Agency, Office of Research and Development, Mid-Continent Ecology Division, 999 18th Street, Suite 300, Denver, CO 80202, 303-312-7022, schweiger.billy@epa.gov

Co-authors: Ted Angradi, U.S. Environmental Protection Agency, Office of Research and Development, Denver, CO; David Bolgrien, U.S. Environmental Protection Agency, Mid-Continent Ecology Division, Duluth, MN; Tony Selle and Karl Hermann, U.S. Environmental Protection Agency, Region 8, Denver, CO; Max Viger, Daston Corporation, Denver, CO

Landscape structure and composition impact ecological processes that affect receiving waters and thus should be included in ecological assessments of large river systems. As part of ongoing research on the Missouri River between Garrison Dam and Lake Oahe in North Dakota, we calculate multiple measures of landscape pattern, condition and stress as quantified by the National Land Cover Dataset with methods developed by the Landscapes component of the U.S. EPA's Environmental Monitoring and Assessment Program (EMAP). Typical measures include a suite of forest core area structural indices (i.e., fragmentation and juxtaposition), the proportion of river length adjacent to urban land use, and estimates of phosphorous and nitrogen loadings. Measures are generated for two reporting units: 1) mesoscale watersheds delineated using thresholds derived from slope-area relationships, and 2) arbitrary thiessen polygons. We also assess temporal patterns (1971 to 1991) in land use practices by analyzing change in a simple land use classification of multispectral scanner data. We will report on 1) multivariate models of patterns among the landscape measures in order to help understand their covariance structure and potential importance as predictors, and 2) trend analyses of how landscape condition has changed in the Garrison area over two decades. Our eventual goal is to develop models of association between remotely sensed measures of landscape condition and site-scale riparian/shoreline data gathered in EMAP's Upper Missouri River Pilot Project. Models linking landscape and local condition would enable timely, cost effective approaches for monitoring, targeting and understanding ecosystem health. This abstract does not necessarily reflect EPA policy.

BIO: Billy Schwieger is a landscape and community ecologist. He has been with EPA since 1991. He is currently a co-Principle Investigator on EMAP-Upper Missouri River research project.

Managing Missouri River Flood Plain Habitats in an Altered Landscape

Doug Helmers
USDA Natural Resources Conservation Service, 1100 Morton Parkway, Chillicothe, MO 64601, 660-646-6220, doug.helmers@mo.usda.gov

Co-authors: Dale Humburg, Missouri Department of Conservation, Columbia, MO; Amanda C. McColpin and Leigh H. Frederickson, University of Missouri, Columbia, MO; and Andrew H. Raedeke, Missouri Department of Conservation, Columbia, MO

Modern wetland restoration and management strategies largely have been developed in the context of highly altered systems. The Missouri River, for example, has lost 8% of the river length, >50% of the river surface area, 98% of the sandbars, and 63% of the floodplain forest as 95% of the native vegetation was converted to agriculture during the last century. We determined waterbird use of 140 basins along 900 km of the Missouri River in Missouri, Kansas, Nebraska, and Iowa during March-September 1995-1998 and during July-August 1999-2000. The relative use of different basins by more than 70 waterbird species and 768,700 individuals showed that a comprehensive restoration and management strategy, including both public and private lands, will be necessary to ensure waterbird use across the range of environmental conditions. Disparate use among habitat types and years by dabbling ducks, coot, wading birds, and shorebirds was explained by annual differences in seasonal flooding and frequent perturbations by landowners. Seasonal wetlands, for example,

were flooded <50% of the time, but were mowed, tilled, or cropped more than 70% of the time during March to September. Restoration strategies that favor intensive management to ensure food production, and extensive infrastructure that provides water management capabilities to ensure food availability are complemented only in some years by seasonal wetlands on private land. Although the timing of inundation generally corresponded to snowmelt, rainfall, and flooding events, the influence of mainstem reservoirs on river levels and basin alteration by farmers had significant effects on wetland availability. Realistic strategies for intensively managed wetlands versus highly altered seasonal basins should be based on an understanding of the relative impact of altered wetland processes versus physical changes in basin condition.

BIO: Doug Helmers is the Wetland Emphasis Team Leader for the Natural Resources Conservation Service in Chillicothe, MO. He was the Project Coordinator for the Missouri River Post-Flood Evaluation study for five years. He is now working on a study of waterbird use of managed, unmanaged, and agricultural wetlands in the Missouri River flood plain. Doug has a B.S. and M.S. in Wildlife Management from the University of Missouri – Columbia.

A Multi-disciplinary Study of Flood Plain Wetland Ecology at Lisbon Bottom, Missouri

Duane Chapman
U.S. Geological Survey, Columbia Environmental Research Center, 4200 New Haven Road, Columbia, MO 65201, 573-876-1866, duane_chapman@usgs.gov

A study integrating elements of hydrology, limnology, and fish, insect, and avian ecology was performed on wetlands at Lisbon Bottom, Missouri. The objectives of the study were to 1) Evaluate hydrologic conditions in wetland and chute habitats in relation to water sources, 2) determine limnological dynamics of wetlands in relation to hydrologic influence, 3) determine dynamics of bird, invertebrate, and fish communities, and 4) relate biological responses to hydrologic, physical, and limnological factors. Habitats that were influenced by intermittent streams had more inundated vegetation and had higher invertebrate densities. Birds used these wetlands more heavily and foraged there. Those same habitats had lower nutrient concentrations, less algal productivity and were not as important for fish. Wetlands had differing fish and aquatic invertebrate faunas after the flood, despite the fact that most of the bottom was entirely covered with a single sheet of water during periods of flooding. Wetlands with similar hydrology and morphology had similar faunas. The wetland invertebrate fauna was very different from river fauna, indicating that most aquatic invertebrates were produced on the flood plain and not brought in from the river during the flood events.

BIO: Duane Chapman is a Fisheries Biologist at the U.S. Geological Survey, Columbia Environmental Research Center in Columbia, MO.

Purple loosestrife - Can We Control It?

Stevan Knezevic
University of Nebraska, Haskell Ag Lab, Concord, NE 68728, 402-584-2808, sknezevic2@unl.edu

Purple loosestrife *(Lythrum salicaria)* is in invasive weed species that is currently taking over thousands of acres of wetlands and waterways in mid-Western states including Nebraska. Once a wetland is taken over by loosestrife, the natural habitat is lost and the productivity of native plant and animal communities is severely reduced. Loss of habitat and wildlife interferes with various levels of the ecosystem and influences many recreational activities creating a negative effect on the social and economic well being of local communities. With the loss of recreational land for fishing, boating and hunting, the local communities also lose revenues from tourism.

A single control measure cannot provide long term, sustainable, control of this weed. Research project was initiated in year 2000 to evaluate an integrated control approach. An integrated management approach includes the use of a variety of mechanical, cultural, biological and chemical control methods. The overall goal of this presentation is to provide a research update on evaluations of various herbicides and mechanical control methods such as repeated mowing and repeated disking.

BIO: Stevan Knezevic is Assistant Professor and Integrated Weed Management Specialist with University of Nebraska, a 50/50 research/extension appointment. His office is at Haskell Ag Lab, the University of Nebraska North East Research and Extension Center at Concord, about 30 miles west of Sioux City.

Wednesday, April 24

Concurrent Session 1

Biological Resources Trends • Habitat Relationships

8:30 a.m. - Noon

USGS

The Missouri National Recreational River

GEOGRAPHIC INFORMATION SYSTEMS (GIS) • LAND USE • RECREATIONAL USE

Temporal Changes in Land Use Practices in the Missouri River Watershed, South Dakota

Ken Higgins
South Dakota Cooperative Fish and Wildlife Research Unit, Biological Resource Division, U.S. Geological Survey, South Dakota State University, Box 2140B, Brookings, South Dakota 57007, 605-688-6121, terri_symens@sdstate.edu

Co-authors: D.E. Naugle, Wildlife Biology Program, School of Forestry, University of Montana, Missoula, MT and K.J. Forman, U.S. Fish and Wildlife Service, Brookings Wildlife Habitat Office, Brookings, SD

Bigger and faster farm equipment, fewer farmers, larger farms, less diversity in cropping systems, and larger-sized livestock are among the factors contributing to the destruction or conversion of remaining natural wetlands and prairie sod remnants in the Northern Great Plains. Although conservationists have been aware of the negative effects of intensified farming practices in the Northern Great Plains on wildlife and their habitats for several decades, most are not aware of some fairly recent changes in farming and crop processing practices that perpetuate even greater risk to natural resources within the Missouri River Watershed. Using socio-economic, agricultural statistics and human resource data sources, we will demonstrate how recent changes in traditional land use practices and farm demographics in South Dakota and nearby states are resulting in greater acreages of unsuitable habitats for prairie wildlife. We will also demonstrate how well natural resource agencies and institutions have been doing at preserving wetland and native prairie upland habitats in this region in the past. Our summary will emphasize the need for accelerated preservation efforts relative to wetland and remnant native prairie grasslands in the Northern Great Plains during this decade and beyond.

BIO: Ken Higgins has been involved with floral, faunal and habitat research in the Northern Great Plains for over 35 years. He is currently the Assistant Leader of the South Dakota Cooperative Fish and Wildlife Research Unit of the U.S. Geological Survey and also serves as a Professor of Wildlife and Fisheries Sciences at South Dakota State University at Brookings, South Dakota. Ken has been involved in Missouri River Studies since 1986.

Development of a Decision Support System for the Missouri River – Lessons Learned from the Upper Mississippi

Carl Korschgen
U.S. Geological Survey, Columbia Environmental Research Center, 4200 New Haven Road, Columbia, MO, 573-876-1901, karl_korschgen@usgs.gov

The overall goal of this project was to document present day conditions, project the future condition (50 year projection), and establish the desired future condition as prescribed by resource managers and the public. Carl's contract portion of the assessment was addressing system-wide habitat needs for birds, fish, mammals,

reptiles, amphibians, and selected invertebrates in the Upper Mississippi and Illinois river corridors and four tributaries, totaling 1,158 river miles.

BIO: Carl Korschgen transferred in 2001 to the Columbia Environmental Research Center from the USGS Upper Midwest Environmental Science Center in La Crosse, WI. As chief of Terrestrial Science Branch at the La Crosse facility, one of many of Carl's role was the co-team leader of the Long Term Resource Monitoring Program (LTRMP) component of the Environmental Management Program for the Upper Mississippi River. The USGS Upper Midwest Environmental Sciences Center is responsible for the LTRMP through a contract with the U. S. Army Corps of Engineers. The annual budget of the LTRMP was over $5 million, which funded six field stations staffed by state scientists and a core of component specialists, GIS specialists, and management and administrative personnel. Carl was also the team leader for a contract for a *Habitat Needs Assessment for the Upper Mississippi River System.*

Depth Analysis on the Missouri River

Kevin C. Borisenko and Lee G. Hughes
Missouri Department of Conservation, 2901 West Truman Blvd., Jefferson City, MO 65109, 573-751-4115, borisk@mail.conservation.state.mo.us

We studied the relationship between Missouri River flows and areas of shallow water. U.S. Army Corps of Engineers (COE) sounding data provide a means to interpolate the Missouri River channel bed. These and other data including 15ft digital elevation models, flow rating curves, U.S. Geological Survey stream flow data, and COE water surface profiles, allow Missouri River depths to be estimated at varying flow regimes. Analyses of these data allowed for quantifying acres and juxtaposition of any given depth class. The information was then used to produce three-dimensional models for a fly-through at each of three variant water stages. Our results suggest that areas of shallow water increase with diminishing river flows.

BIO: Kevin C. Borisenko began his GIS career with Missouri Department of Conservation (MDC) in 1994 as a GIS Technician. He received his B.A. in Geography from the University of Missouri-Columbia in 1995 and in 1996 became a GIS Analyst at MDC. Since 2000, Kevin has been a GIS Specialist. Lee G. Hughes has been a GIS Specialist with MDC since 1999. He received a Masters in Wildlife Science from the University of Wyoming in Laramie in 1997 after receiving a B.S. from New Mexico State University in Las Cruces, NM.

Using Digital Data Collection and the Internet – A Solution for Data Management

Bruce A. Vander Lee
U.S. Army Corps of Engineers, P.O. Box 710, Yankton, SD 57078, 402-667-7873, bruce.a.vanderlee@usace.army.mil

The U.S. Army Corps of Engineers implemented a digital data collection system and an internet based data management system (DMS) to help meet its needs managing endangered least terns and threatened piping plovers on the Missouri River. Field

crews, armed with global position systems and handheld computers, survey piping plover and least tern nesting areas to record nesting, productivity, census, and location information directly into the handheld computer. In the office, the data is uploaded to the web based DMS. Once checked for quality control, the data is made available in various reports and graphs via the DMS. While still in development, the system provides many benefits for the Corps' Threatened and Endangered Species Program, including increased data quality, stringent data quality control and data security, increased field crew efficiency, and near real-time information for making water management decisions. The system also helps the Corps fulfill many outreach needs by making current and historical data widely available and easily accessible to important users outside the Corps.

BIO: Bruce Vander Lee is a Consultant working with the Corps of Engineers on habitat issues for endangered species on the Missouri River. He also assists the Corps Threatened and Endangered Species program with data management issues.

An Examination of the Physical Environment of the Lower Missouri River

William W. Little
Missouri Department of Natural Resources, Geological Survey and Resource Assessment Division, P.O. Box 250, Rolla, MO 65402, 573-368-2100, nrlittb@mail.dnr.state.mo.us

Co-authors: Ardel Rueff, Missouri Department of Natural Resources, Geological Survey and Resource Assessment Division, Rolla, MO; John Drew and Robert R. Bacon, Missouri Department of Natural Resources, Geological Survey and Resource Assessment Division, Jefferson City, MO

Historically, the Missouri River had a wide, active flood plain with multiple channels, frequent flooding, and abundant wildlife habitat. The lower river has become a highly engineered, single channel waterway. Flood plains have been protected with levees, and forests have been cleared for agricultural and urban uses. Despite these measures, flooding continues to be a problem.

Because of numerous competing uses on the Missouri River present river management practices are currently being reviewed. Proposed modifications to the present management plan range from returning the river to a natural state to controlled-flow plans that attempt to balance the desires of this wide range of interest groups. One of the primary obstacles in selecting a balanced plan is a lack of adequate field data to assist in predicting the benefits and consequences of the various alternatives.

The Missouri Department of Natural Resources, Geological Survey and Resource Assessment Division is beginning a long-term investigation to evaluate and map the physical environment of the lower Missouri River from near Rulo, Nebraska to its confluence with the Mississippi River, a distance of nearly 533 miles that includes nearly one-million acres. The study comprises such issues as flood plain geology, geomorphology, and flow variability as they relate to the physical habitat and the dynamics associated with the river system. In this new era of adaptive management, much research in the physical sciences is needed to make appropriate recommendations.

BIO: Bill Little is a geologist with the Missouri Department of Natural Resources, Geological Survey and Resource Assessment Division, in Rolla, Missouri. He teaches part-time at the University of Missouri – Rolla and Drury University in Rolla. He received his Ph.D. from the University of Colorado-Boulder in 1995.

Influence of Katy Trail State Park and Lewis and Clark Activities on Missouri River

Douglas Eiken
Missouri Department of Natural Resources, Division of State Parks, P.O. Box 176, Jefferson City, MO 65102, 573-751-9263, nreiked@mail.dnr.state.mo.us

The Missouri River is a significant feature of Missouri, dividing the state geographically, but also connecting it together with common uses and history. Recreation has always been a feature of the river, with the most common uses being fishing, boating and viewing nature. Since 1990, there has been a new aspect related to Missouri River recreation. Katy Trail State Park follows the Missouri River for 165 miles with many areas that are adjacent. Along with hiking and bicycling, the trail provides an upclose venue for viewing the river and its wildlife, especially migrating waterfowl and birds that make their home in wetlands. It has been estimated that between 300,000 and 400,000 people use the trail annually.

Recreational use of the river is expected to increase dramatically in the next several years as people follow the journey of the Corps of Discovery. The 200th anniversary of the Lewis and Clark Expedition will be commemorated in 2004-2006 with activities, festivals and re-enactments. Officials predict that thousands of people will flock to the river, not only in boats to follow the journey but to the banks where interpretive information will be provided. This will bring much more attention to the Missouri River and potentially increase its use for other recreational uses as well.

BIO: Doug Eiken is the director of the Division of State Parks within the Missouri Department of Natural Resources. Appointed in 1994, he is responsible for 82 state parks and historic sites, a budget in excess of $44 million and a staff of 730. Prior to 1994, he was the director of the North Dakota Department of Parks and Recreation for 13 years. He is currently a member of the Mississippi River Parkway Commission of Missouri and the National Recreation and Parks Association, and serves as the acting executive director of the Missouri Lewis and Clark Bicentennial Commission. He has served as the president of both the National Association of State Park Directors and the National Association of State Outdoor Recreation Liaison Officers. He has a B.S. in mathematics and physical education from Mayville State University in North Dakota, a M.S. in physical education from Moorhead State University in Minnesota, and a Ph.D. in leisure services administration from the University of Utah.

Angling Recreational Use Patterns and Economics on the Missouri River System in South Dakota

Clifton Stone
South Dakota Game, Fish & Parks, 1125 N. Josephine, Chamberlain, SD 57325, 605-734-4538, cliff.stone@state.sd.us

Co-author: John Lott, South Dakota Game, Fish & Parks, Chamberlain, SD

The Missouri River, including the river segments and reservoirs, provide a large and diverse portion of available fishing opportunity in South Dakota, contributing more than 500,000 angler days of recreation in recent years. The importance of the Missouri River system to South Dakota anglers was documented in a 1992 angler use

and preference survey in which 50 percent of the respondents listed the "Missouri River and its reservoirs" as their preferred fishing area. South Dakota Department of Game, Fish and Parks has conducted angler use and harvest surveys on Lake Francis Case, Sharpe, and Oahe annually since 1991. Over the decade of the 1990's angler use on these three large Missouri River reservoirs has averaged over 2.3 million angler hours annually, with an average annual harvest of over 810,000 fish including over 670,000 walleye. Over this same time-period, non-resident anglers from 30 states (including all of those in the Missouri River basin) have participated in these fisheries, annually contributing about 25 to 30 percent of the angling use. This paper will discuss the results of those surveys with special emphasis on angling recreational use patterns and economics.

BIO: Clifton Stone is a Senior Wildlife Biologist with the South Dakota Department of Game, Fish and Parks working in their Reservoir Fisheries Program. He is responsible for fisheries management and research activities on the Missouri River and reservoirs from Big Bend Dam downstream to the South Dakota/Iowa border.

Missouri River Creel Survey

Kirk Steffensen
Nebraska Game and Parks Commission, 2200 North 33rd Street, Lincoln, NE 68503, 402-471-5447

Co-author: Gerald Mestl, Nebraska Game and Parks Commission, Lincoln, NE 68503

Creel surveys were conducted on reaches of the channelized Missouri River in Nebraska in 2000 and 2001. These are the first of a series of annual creel surveys to be conducted on alternating sections of the channelized Missouri River to measure changes in recreational fishing activity, especially those changes due to large-scale habitat restoration efforts.

Anglers spent over 55,000 hours fishing the Missouri River from the Bellevue Bridge (rkm 967.7) to Camp Creek (rkm 883.5) from 1 April to 15 September 2000. Effort peaked during the 29 April to 26 May creel period and was highest in the Nebraska City and Plattsmouth segments. Anglers targeted catfish (blue, channel and flatheads) over half of the time that they were fishing. Bank anglers accounted for nearly 58% of the total effort. Wing dikes were the most commonly fished macrohabitat.

Anglers caught nearly 24,000 fish and harvested over 9,000 fish from 1 April through 15 September while fishing the survey reach of the Missouri River. Over 50% of the catch occurred during the first two creel periods, 1 April through 26 May, and occurred in the Nebraska City and Plattsmouth segments. Total catch rates ranged from 0.35 fish per hour from 24 June through 21 July to 0.6 fish per hour from 1 April through 28 April. Channel catfish were the most abundant species in the creel, followed by common carp, freshwater drum, shovelnose sturgeon and flathead catfish.

BIO: Kirk Steffensen received his B.S. from Wayne State in 2000 and started with Nebraska Game and Parks Commission as a Conservation Technician that same year. In September 2001, Kirk was promoted to Biologist and is currently working on a pallid sturgeon monitoring project funded by the Corps of Engineers.

Nebraska and South Dakota 2000 Missouri River Recreational Use Survey

David Tsoodle
Nebraska Game and Parks Commission, 2200 North 33rd Street, Lincoln, NE 68503, 402-471-5447

Co-authors: Gerald Wickstrom, South Dakota Game, Fish and Parks Department, Chamberlain, South Dakota 57325; Gerald Mestl, Nebraska Game and Parks Commission, Lincoln, NE 68503

The 2000 Missouri River recreational survey ran April 1, 2000 through December 31, 2000 and surveyed the Ft. Randall Dam to Big Sioux River reach. Recreational user data was collected from postage paid post cards left on vehicles and through personal interviews. Pressure data was collected from ground counts of vehicles, boat trailers and recreational users. Aerial counts were made to compare angling and recreational boating data with ground count data.

Recreational users spent an estimated 745,303 hours on the Missouri River survey reach during 2000. Fishing accounted for an estimated 458,749 hours, or 62% of all recreational use. Recreational boating accounted for an estimated 255,736 hours, or 34% of all use. Hunting, camping, picnicking, sightseeing, observing wildlife, outdoor photography, and other uses accounted for only about 4% of the total use.

Over 69% of all recreational users indicated they would access the river eight or more times per year. Nearly 79% of the recreational users indicated that the access facilities met their needs. Approximately 42% of the recreational users were involved in trips that included an overnight stay. Most recreational users stayed at state park campgrounds, followed by motels, state park cabins, private cabins, and private campgrounds in that order.

Recreational anglers caught an estimated 455,988 fish, and harvested an estimated 159,420 fish from the reach during the survey period. Walleye was the single most harvested species at an estimated 29,676 fish and supported a catch rate (harvest rate and release rate combined) of 0.22 fish/hour. Freshwater drum was the second most harvested species at an estimated 20,638 fish, with a catch rate of 0.10 fish/hour. Catfish (channel, blue, flathead, and bullheads) was the most abundant species group in the creel at an estimated 36,500 fish, with a catch rate of 0.21 fish/hour.

Anglers from 29 states were contacted during the survey, with approximately 88% of them being from either Nebraska or South Dakota. Walleye were preferred by approximately 45% of the anglers fishing the survey reach, followed by catfish at 21%. Over 60% of the anglers expressed some degree of satisfaction with their angling experience. The majority of the anglers were in favor of the 15-inch minimum length limit for walleye, sauger, and hybrids.

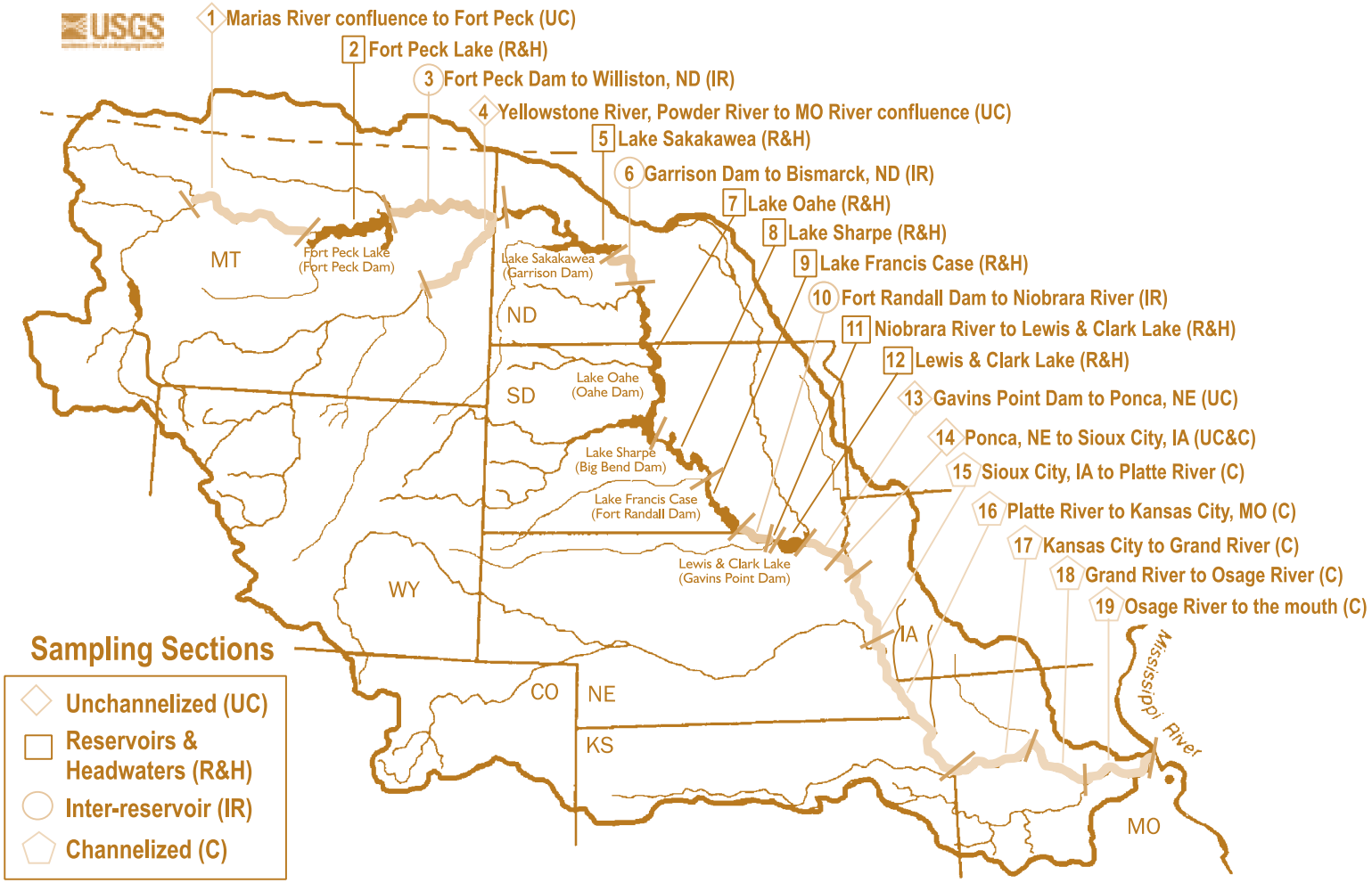
BIO: David Tsoodle started working for the Nebraska Game and Parks Commission in 2000 as a Conservation Technician. He graduated from Northeastern Oklahoma State University with a B.S. in Fish and Wildlife Biology in 1987. He worked as an graduate assistant at Montana State Cooperative Fishery Research Unit from 1982 – 1986 and the U.S. and Wildlife Service in 1990 on a cooperative education project.

Notes

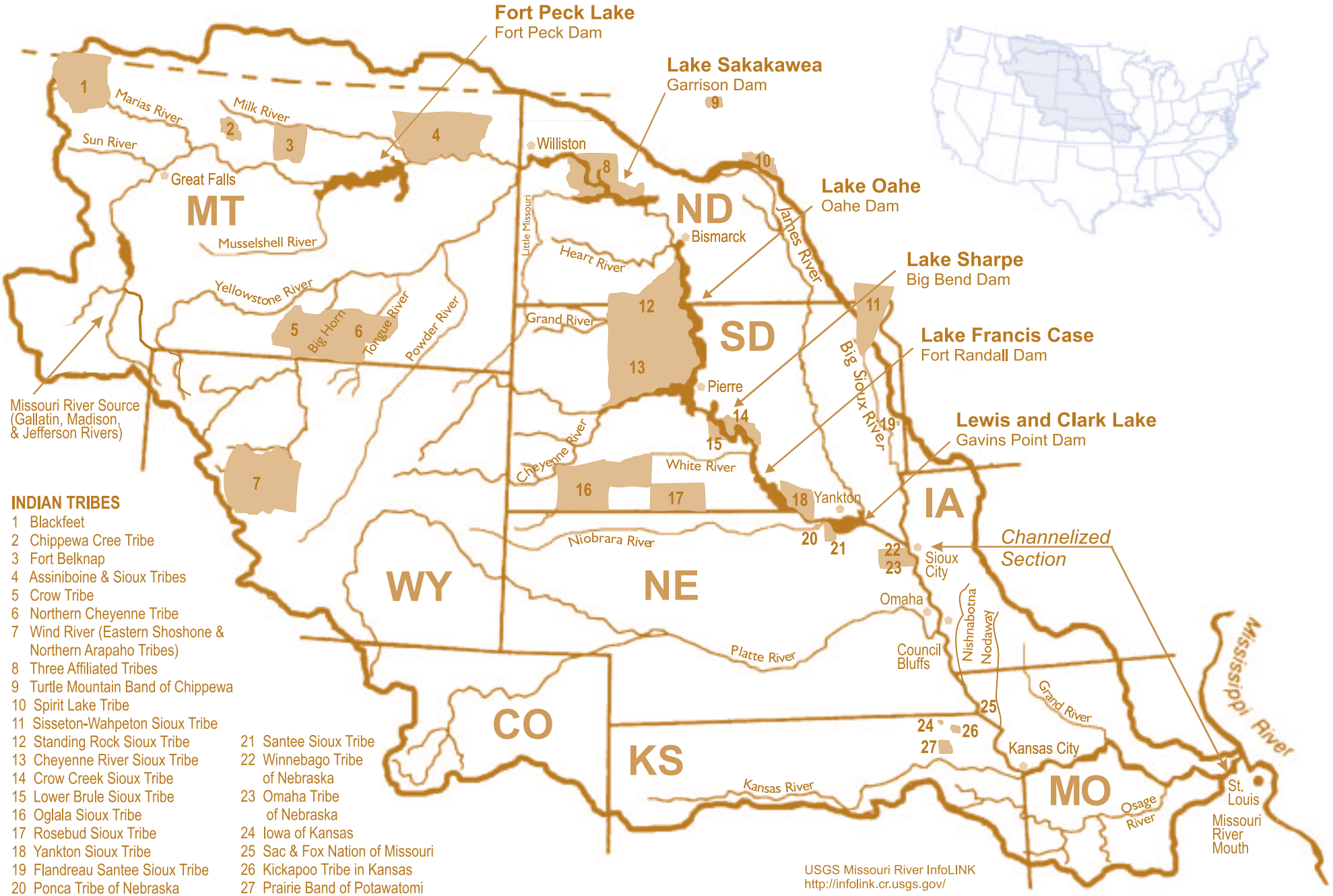
Proposed

Missouri River Environmental Assessment Program

Sampling Segments



MISSOURI RIVER BASIN



INDIAN TRIBES

1 Blackfeet
2 Chippewa Cree Tribe
3 Fort Belknap
4 Assiniboine & Sioux Tribes
5 Crow Tribe
6 Northern Cheyenne Tribe
7 Wind River (Eastern Shoshone & Northern Arapaho Tribes)
8 Three Affiliated Tribes
9 Turtle Mountain Band of Chippewa
10 Spirit Lake Tribe
11 Sisseton-Wahpeton Sioux Tribe
12 Standing Rock Sioux Tribe
13 Cheyenne River Sioux Tribe
14 Crow Creek Sioux Tribe
15 Lower Brule Sioux Tribe
16 Oglala Sioux Tribe
17 Rosebud Sioux Tribe
18 Yankton Sioux Tribe
19 Flandreau Santee Sioux Tribe
20 Ponca Tribe of Nebraska
21 Santee Sioux Tribe
22 Winnebago Tribe of Nebraska
23 Omaha Tribe of Nebraska
24 Iowa of Kansas
25 Sac & Fox Nation of Missouri
26 Kickapoo Tribe in Kansas
27 Prairie Band of Potawatomi